2.0 HSW EIS Waste Streams and Waste Management Facilities

This section describes:

- the four waste types: low-level waste (LLW), mixed low-level waste (MLLW), transuranic (TRU) waste, and Waste Treatment Plant (WTP) waste[(a)]
- the specific waste streams within the four waste types
- the waste management facilities that are currently being used
- the new or modified facilities that are being evaluated in this HSW EIS.

Additional information on Hanford waste streams and facilities is contained in Appendixes B, C, and D and the Technical Information Document (FH 2003).

2.1 Solid Waste Types and Waste Streams Related to the Proposed Action

Historically, solid LLW was disposed of in shallow-land disposal units. In 1970, a U.S. Department of Energy predecessor agency, the U.S. Atomic Energy Commission (AEC), determined that waste containing TRU radionuclides would be managed separately from LLW and stored until an appropriate disposal facility was available. Beginning at that time, the suspect TRU waste was placed into retrievable storage (hence, it is sometimes called "retrievably stored").

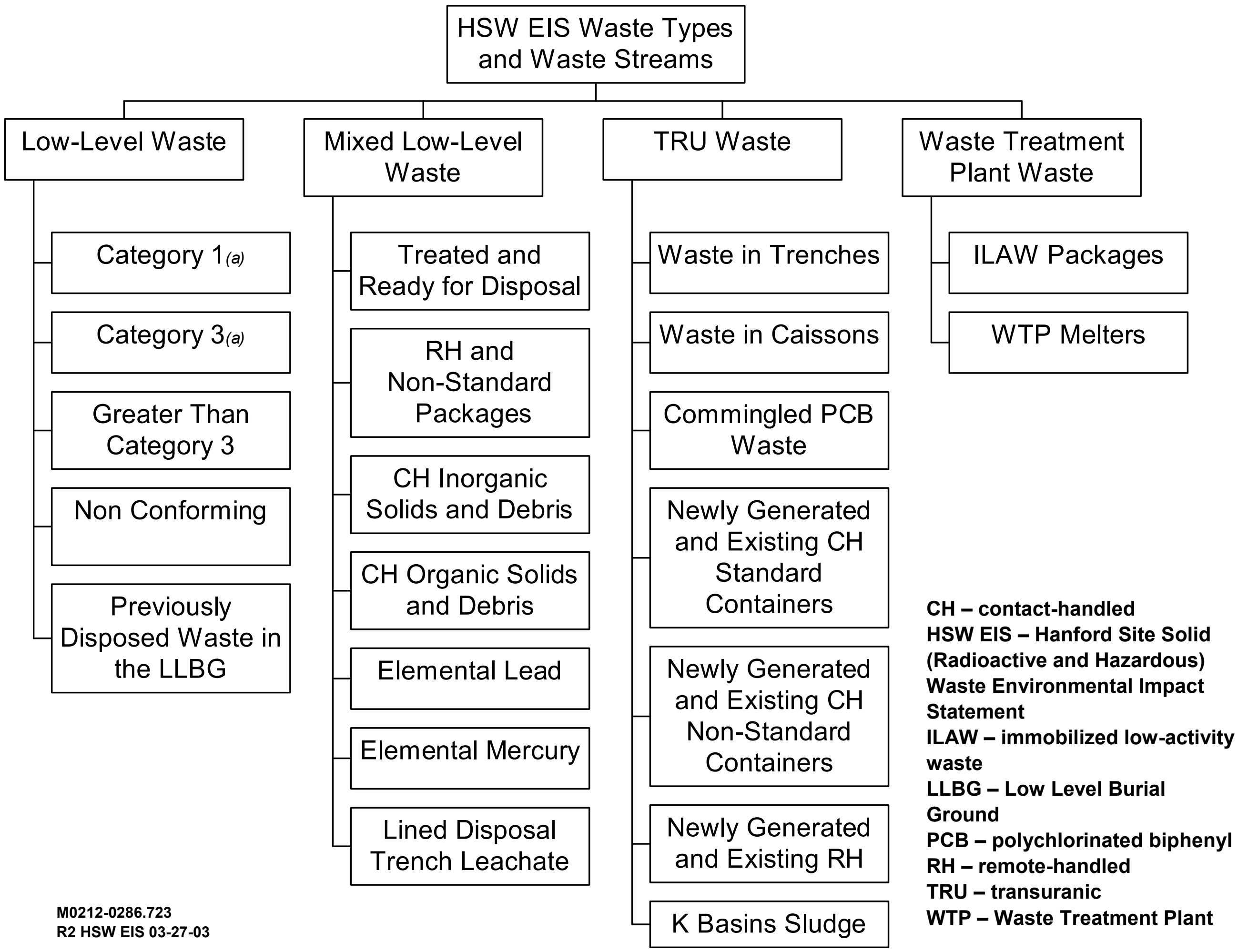
In 1987, DOE directed that radioactive waste containing chemically hazardous components, as identified under the Resource Conservation and Recovery Act (RCRA) of 1976 (42 USC 6901 et seq.), be separated and managed separately from LLW (10 CFR 962.3). This waste, referred to as MLLW, is placed into above ground storage facilities at Hanford until it can be treated and disposed of.

The treatment of the Hanford tank waste as part of the River Protection Project within the WTP will result in several waste streams. Of those waste streams, ILAW and melters are being specifically considered in this EIS.

Each of the four waste types has been further divided into waste streams for analysis in this HSW EIS. For the purposes of this EIS, a waste stream is defined as waste with physical and chemical characteristics that would generally require the same management approach (i.e., using the same storage, treatment, and disposal capabilities). The waste types and waste streams considered within this EIS are shown in Figure 2.1. Brief descriptions of the waste streams are contained in subsequent sections. Information on the volume of waste associated with each stream is provided in Section 3.3.

(a) The WTP wastes (immobilized low-activity waste and melters) as evaluated are MLLW, but are considered a separate waste type for the discussions in this EIS.

Radioactive waste may be contact-handled (CH) or remote-handled (RH) waste. CH waste has a dose rate less than 200 millirem/hr as measured with the detector in contact with the container and can be handled without shielding. The RH waste classification applies to containers with a contact dose rate greater than 200 millirem/hr. RH waste requires the use of additional shielding and special facilities to protect workers.



(a) Category 2 LLW is no longer considered a separate waste stream. See Section 2.1.1.2 for explanation.

Figure 2.1. Waste Types and Waste Streams Considered in the HSW EIS

2.1.1 LLW Streams

Low-level waste may be generated during the handling of radioactive materials, which results in the contamination of items and materials. Because many different activities are conducted using different types of radioactive materials and levels of radioactivity, there is a wide variation in the chemical and physical characteristics of waste and levels of contamination. Most of the LLW currently in the Low

Level Burial Grounds (LLBGs) was generated by analytical laboratories, reactors, separation facilities, plutonium processing facilities, and waste management activities. At Hanford, solid LLW includes protective clothing, plastic sheeting, gloves, paper, wood, analytical waste, contaminated equipment, contaminated soil, nuclear reactor hardware, nuclear fuel hardware, and spent deionizer resin from purification of water in radioactive material storage basins. In the foreseeable future, analytical laboratories, research operations, facility deactivation projects, waste management activities, and other onsite and offsite activities would likely continue to generate LLW.

Typical containers used for burial of LLW include 208-L (55-gal) metal drums and boxes nominally 1.2 m by 1.2 m by 2.4 m (4 ft by 4 ft by 8 ft) in size. Other boxes are made in various sizes to accommodate specific waste items. Cardboard, wood, and fiber-reinforced plastic boxes have also been used. Large items or equipment may be wrapped in plastic. However, some bulk waste (that is, soil or rubble) is disposed of without containers.

Both onsite and offsite generators of LLW are required to meet specific criteria for their wastes to be accepted for disposal at Hanford. Those requirements are defined in the *Hanford Site Solid Waste Acceptance Criteria* (HSSWAC) (FH 2003) and include requirements on the waste package, descriptions of the contents of the waste package, the radionuclide content, physical size, and chemical composition. To verify that generators conform with the HSSWAC, a random sample of incoming CH waste is periodically selected for verification at the Waste Receiving and Processing Facility (WRAP), the T Plant Complex, or other appropriate location. Verification of RH waste is typically conducted at the generating facility. Discovery of non-conforming waste can result in rejection of the waste with its return to the generator, or the need for removal or treatment of prohibited items at the generator's expense. Most LLW is only stored for short periods of time awaiting verification or disposal.

The HSSWAC also define LLW categories summarized below by radionuclide activity level. The categories are based on site-specific performance assessments that were conducted in conformance with DOE Manual 435.1-1 (DOE 2001a). The HSSWAC should be consulted for technical details defining Category 1 (Cat 1), Category 3 (Cat 3), and greater than Category 3 (GTC3) wastes. Cat 1 wastes have lower concentrations of radionuclides than Cat 3 wastes. All Cat 1 and Cat 3 wastes that meet the HSSWAC requirements can be disposed of in the LLBGs. GTC3 wastes have even higher concentrations of radionuclides than Cat 3 wastes and require a specific analysis to determine whether they can be disposed of in the LLBGs. Cat 3 and GTC3 LLW are subject to additional disposal requirements because they contain higher concentrations of long-lived mobile radionuclides.

The U.S. Nuclear Regulatory Commission (NRC) in 10 CFR 61.55 defines four classes of LLW (A, B, C, and greater than Class C). The NRC requirements apply to all commercial LLW disposal sites. The HSSWAC only apply to Hanford and are adjusted for specific Hanford conditions. Therefore the radionuclide concentrations specified for each NRC class are not necessarily the same as those defined in the HSSWAC for LLW categories.

2.1.1.1 Low-Level Waste – Category 1

Cat 1 LLW represents the largest volume of waste expected at the Hanford Site. It has the lowest concentrations of radioactivity and can be directly placed into the LLBG trenches without treatment and in some cases without additional packaging. Cat 1 LLW can be either CH or RH waste.

2.1.1.2 Low-Level Waste – Category 3

In the original development of the waste categories, Category 2 LLW was defined. However, this category resulted in a small volume of waste and the previous Category 2 material is now managed as Cat 3 LLW. Cat 3 LLW is defined as having radionuclide concentrations greater than limits specified in the HSSWAC for Cat 1 LLW, but lower than maximum concentration limits defined for Cat 3 LLW. Cat 3 LLW is similar to Cat 1 LLW except that it has higher concentrations of certain radionuclides, and requires greater confinement for burial in the LLBGs (FH 2003). Cat 3 LLW may also be CH or RH waste. Greater confinement in the LLBGs has typically been provided either by packaging the wastes in high-integrity containers (HICs) or by in-trench grouting prior to burial (Section 2.2.3). Typical sources of the Cat 3 LLW are operation or cleanout of hot cells and canyon facilities, removal of HLW storage tank equipment, examination of irradiated reactor fuel assembly components, and other operations that handle higher activity items.

2.1.1.3 Low-Level Waste – Greater Than Category 3

GTC3 LLW exceeds the radionuclide concentration limits for Cat 3 LLW. GTC3 LLW requires a specific evaluation to demonstrate that requirements of the LLBG performance assessments would be met before it can be disposed of at Hanford. GTC3 LLW can generally be disposed of in the same manner as Cat 3 LLW in HICs or by in-trench grouting. The sources of GTC3 LLW are similar to Cat 3 LLW. No GTC3 LLW is currently forecast; however, a small volume of this waste is analyzed in this EIS to address future contingencies.

2.1.1.4 Low-Level Waste – Non-Conforming

Non-conforming LLW is waste that does not meet the current HSSWAC for burial and cannot readily be treated to meet those requirements. Waste containers may not exceed one percent free liquid by volume. Non-conforming waste needs to be processed so it conforms with the HSSWAC.

2.1.1.5 Waste Previously Disposed of in the Low Level Burial Grounds

This waste stream includes all waste that has been disposed of in the LLBGs described in Appendix D except for the retrievably stored TRU waste. The previously buried waste constitutes waste that has been disposed of. This waste is included in the EIS analysis of LLBG closure, long-term, and cumulative impacts.

2.1.2 Mixed Low-Level Waste Streams

Regulatory information for mixed wastes can be found in Sections 6.3 and 6.4. Both onsite and offsite MLLW must also meet requirements of HSSWAC. Some waste is subject to Washington State RCRA program (regulated under the Dangerous Waste Regulations, Chapter 173-303 WAC) with delegated authority for implementation of the Federal RCRA program and independent state statutory authority pursuant to the Washington State Hazardous Waste Management Act (RCW 70.105). In addition, Hanford has some LLW that also contains polychlorinated biphenyls (PCBs), which are regulated under the Toxic Substances Control Act (TSCA) of 1976 (15 USC 2601 et seq.). TSCA wastes are being managed similar to mixed wastes and are included in MLLW inventories and projections. In addition, wastes that are not considered hazardous by the U.S. Environmental Protection Agency (EPA) may be managed as MLLW because they are considered toxic, persistent, or corrosive by state regulations. MLLW was generated by activities similar to those that created LLW, and the two types of waste were not differentiated until 1987. Beginning in 1987, DOE determined that radioactive wastes mixed with hazardous wastes would be designated under RCRA, and would be managed in accordance with RCRA (10 CFR 962.3). Accordingly, DOE has acquired regulatory-compliant waste management storage facilities through building new, or modifying existing Hanford facilities.

Hanford's MLLW was generated from operations, maintenance, and cleanout of reactors, chemical separation facilities, high-level waste (HLW) tanks, and laboratories. MLLW contains the same type of materials as LLW. It typically consists of materials such as sludges, ashes, resins, paint waste, soils, lead shielding, contaminated equipment, protective clothing, plastic sheeting, gloves, paper, wood, analytical waste, and contaminated soil. Hazardous components may include lead and other heavy metals, solvents, paints, oils, other hazardous organic materials, or components that exhibit characteristics of ignitability, corrosivity, toxicity, or reactivity as defined by the dangerous waste regulations.

Extended storage of MLLW is restricted to permitted engineered facilities, such as the CWC. However, pursuant to the applicable regulations, non-permitted facilities may accumulate newly generated MLLW for periods up to 90 days before transferring them to a permitted storage or treatment facility (WAC 173-303-200). Regulatory compliant treatment (generally immobilization or destruction of the hazardous component) is required before most of the MLLW can be sent to a permitted land disposal facility. In some cases, MLLW will already be treated and regulatory compliant when it is received and can be sent directly to the disposal facility. In other cases, the waste will require treatment prior to disposal. Brief descriptions of potential mixed waste treatment technologies are included in the Technical Information Document (FH 2003). The current approach to treatment of MLLW at Hanford uses a combination of onsite and commercial treatment facilities. The Hanford Site currently has limited capacity for MLLW treatment at facilities such as WRAP and the T Plant Complex. Two contracts (discussed in Section 2.2.2.2) were placed with a commercial vendor to begin treating limited quantities of CH MLLW in the year 2000. The contracts were intended to serve as a technical demonstration for future commercial treatment of the majority of Hanford's MLLW (See Section 2.2.2.2). After the waste has been treated and meets the regulatory requirements, it can be disposed of in a regulatory-compliant disposal facility. Hanford currently has two MLLW disposal trenches located in the 200 West Area that are operating under interim status. To minimize settling of the backfill and caps on the burial ground, waste packages are required to be 90 percent full when they are received.

2.1.2.1 Mixed Low-Level Waste – Treated and Ready for Disposal

This waste stream consists of MLLW that has been treated to meet the RCRA and state requirements for land disposal. The River Protection Project (RPP) is expected to be the primary Hanford generator of MLLW. The RPP waste includes long-length equipment (see Figure 2.2) from HLW tank retrieval operations, which would be macroencapsulated. MLLW received from offsite generators is assumed to arrive in a regulatory-compliant form and ready for disposal.

M0212-0286.8
HSW EIS 12-10-02

Figure 2.2. Long-Length Equipment Being Removed from a Tank

2.1.2.2 Mixed Low-Level Waste – RH and Non-Standard Packages

Existing and forecast quantities of RH MLLW cannot easily be treated under the existing MLLW treatment contracts or at onsite facilities. This waste has physical and chemical characteristics similar to other MLLW, but requires a shielded facility and special equipment for remote handling. In the future, some non-standard packages of CH waste may also be received for which there is no treatment facility. This waste would remain in storage until treatment facilities are available.

2.1.2.3 MLLW – CH Inorganic Solids and Debris

Inorganic solid waste may include substances such as sludges, paints, and dried inorganic chemicals. Debris waste must meet criteria defined in state regulations (WAC 173-303-040). Inorganic debris wastes often contain metal, ceramic, and concrete items and may result from removal of failed or obsolete equipment or from disposal of items used during process operations. They may also result from cleanout or decommissioning of inactive facilities. These wastes generally require treatment by stabilization, or macroencapsulation before disposal.

> ***Non-Thermal Treatments***
> such as stabilization and macroencapsulation are used to immobilize radionuclides and hazardous inorganic components using cement or plastics either as a jacket of material around the waste or as a matrix incorporating the waste.

2.1.2.4 MLLW – CH Organic Solids and Debris

Organic solid waste may include substances such as resins, organic absorbents, and activated carbon. Organic debris wastes meet the regulatory requirements for debris wastes (WAC 173-303-040) and have a greater than 10 percent organic/carbonaceous content. Typical wastes include paper, wood, or plastic. These wastes are included as organic/carbonaceous waste in WAC 173-303-140, which requires that they be thermally treated if capacity is available. There are no existing or planned Hanford facilities with thermal treatment capability for solid waste. Until thermal treatment is available within 1610 km (1000 mi) (WAC 173-303-140), DOE has been authorized by the Washington State Department of Ecology (Ecology) to treat organic debris waste by macroencapsulation.

> ***Thermal Treatments***
> are used to destroy organic constituents within the waste. Thermal treatment uses high temperatures and can include processes such as plasma arcs, incinerators, or vitrification.

2.1.2.5 MLLW – Elemental Lead

Lead metal has been used at Hanford and other DOE sites for radiation shielding and in applications where its high density is of benefit. Most of the lead waste has surface contamination and some of the lead is radioactive from neutron activation. Some lead must be treated as mixed waste by macroencapsulation, or other approved technology, before disposal.

2.1.2.6 MLLW – Elemental Mercury

Elemental mercury is a contaminant for several different types of waste. Waste can contain liquid mercury from various items (that is, light bulbs, switches, thermometers, and chemical process equipment). Mercury can be removed from bulk waste by thermal desorption and then solidified by amalgamation. Limited

> ***Thermal Desorption***
> heats the waste to temperatures sufficient to vaporize mercury, which is subsequently condensed in a separate vessel.
>
> ***Amalgamation***
> Solidification of mercury by mixing it with sulfur or other material to form a stable solid.

amalgamation treatment capacity for mercury waste is available at existing Hanford facilities, but additional capability for treatment of the remaining waste is needed.

2.1.2.7 MLLW – Lined Disposal Trench Leachate

This waste stream is generated from operation of lined disposal trenches. It is mostly rainwater or melted snow that is trapped by the collection systems in the lined disposal trenches. It is a liquid waste and is managed differently from the other wastes discussed in this EIS. The liquid waste is currently removed from the lined trenches and trucked to the Effluent Treatment Facility (ETF) where it is treated along with other liquid mixed wastes. Solid waste resulting from the treatment is included in the solid waste streams discussed in previous sections.

2.1.3 TRU Waste Streams

The production of TRU materials, primarily plutonium, was the primary defense mission of the Hanford Site. Most of the Hanford TRU waste was produced in plutonium handling facilities for management of weapons materials or from research on plutonium fuels.

Prior to 1970, TRU waste had not been designated as a separate waste type. In 1970, the Atomic Energy Commission (AEC) determined that waste containing transuranic elements might be associated with increased hazards and should be disposed of in facilities that provide a greater level of confinement than the type of shallow-land burial typically used for disposal of LLW.

The AEC set a minimum concentration level of TRU isotopes at 10 nanocuries per gram of waste. At that time field instrumentation was not available to measure concentrations at that level. Therefore, any waste associated with the handling of plutonium was considered to be suspect TRU waste and was placed in retrievable storage. The definition of TRU waste was changed to 100 nanocuries/gram in 1984. Once it is determined that the concentration of transuranic elements is below 100 nanocuries/gram, the waste would no longer be managed as suspect TRU waste. For purposes of analysis in this EIS, it was assumed to be managed as LLW. An evaluation of the CH waste placed into retrievable storage estimated that 50 percent of the drums currently managed as TRU waste, would be reclassified as LLW (Anderson et al. 1990).

TRU waste has been stored in several different ways at Hanford. TRU waste was initially placed into retrievable storage in the LLBGs, either with or without a soil cover. After 1985 most TRU waste was no longer placed in trenches, but was stored in an existing facility near the T Plant Complex that had been retrofitted for TRU waste storage. This building was known as the Transuranic Storage and Assay Facility (TRUSAF). Waste storage in that facility was discontinued in 1998 and its inventory, along with most newly generated TRU waste, is now stored in the CWC.

TRU waste disposal began in 1999 with the opening of DOE's Waste Isolation Pilot Plant (WIPP) in New Mexico. The Hanford Site began shipping waste to WIPP in July 2000. Wastes to be shipped to WIPP must be certified to meet the WIPP Waste Acceptance Criteria (DOE-WIPP 2002). WRAP was designed and built at Hanford to perform certification of most CH TRU waste for disposal at WIPP, along with several other functions. Currently, CH TRU drums are being removed from CWC, certified at the WRAP, and shipped to WIPP. TRU waste drums are placed in shipping casks known as Transuranic Package Transporter-II (TRUPACT-II) and are transported by truck to the WIPP (see http://www.emnrd.state.nm.us/wipp/trubig.htm for description).

In the future, some TRU waste may be shipped by rail. The consequences of transportation by truck and rail and disposal of TRU waste at WIPP were evaluated in the WIPP Supplemental Environmental Impact Statement (SEIS) II (DOE 1997b) and the WM PEIS (DOE 1997a) and, therefore, are not re-evaluated in this EIS; however, there is general discussion of transportation in Section 2.2.4 and a summary of the previous analysis in Section 5.8.

Some TRU waste also contains hazardous components (mixed TRU waste) and would be managed under RCRA or TSCA. All TRU waste is managed in the same manner, and mixed TRU waste has not been identified as a separate waste type in this EIS. Mixed TRU waste is acceptable at WIPP. DOE's hazardous waste permit for WIPP, issued by the State of New Mexico Environment Department, authorizes the disposal of CH mixed TRU waste. DOE expects to have the capability to transport, receive, and dispose of RH wastes at WIPP in approximately the 2005 timeframe (DOE 2002a).

2.1.3.1 TRU Waste – Waste from Trenches

From 1970 to 1985, the primary method for storage of TRU wastes involved placing drums or boxes of waste on asphalt pads constructed in the bottom of the trenches and covering the drums with wood, plastic, and a layer of soil (see Section 2.2.1.2). The TRU waste was expected to remain there for less than 20 years. Corrosion of the packaging has continued since they were buried and preliminary inspection of some older containers has confirmed deterioration in their condition. However, observations and monitoring of the area around the drums within the trenches have not detected the release of any alpha emitters, such as plutonium.

DOE previously decided to retrieve the TRU waste (DOE 1987; 53 FR 12449) for disposal at WIPP. Because it was previously evaluated, retrieval of the waste is not re-evaluated in this EIS, but the processing of the waste at Hanford is evaluated. The CH drums can be processed, repackaged, and certified at WRAP. However, the capability to process, certify, and ship non-standard boxes or RH wastes to WIPP is not available at the Hanford Site, at other DOE sites, or at commercial facilities. These wastes would be placed in CWC until they can be processed. Processing of these wastes would require development of new capabilities. Both the new facilities and the processing operations are evaluated in this EIS.

2.1.3.2 TRU Waste – Waste from Caissons

Beginning in 1970 through 1988, higher-activity TRU waste was placed in four caissons for retrievable storage. These TRU waste caissons are located in Burial Ground 218-W-4B as shown in Appendix D. Most of the waste in the TRU caissons originated from laboratory activities in hot cells in the 300 Area facilities. About 5500 containers were sent to these caissons. Of those, about 97 percent were 3.8-L (1-gal) cans containing residue from the examination of nuclear fuels and irradiated structural materials.

Some of the individual containers had measured radiation levels in excess of 1500 R/hr at the time of placement. Other wastes included small-scale process equipment used for radionuclide separations operations. For additional information about the caissons see Section 2.2.1.3.

DOE previously decided to retrieve this waste (DOE 1987; 53 FR 12449) for disposal at WIPP. The retrieval of this waste is not re-evaluated in this EIS; however, the processing of this waste is evaluated.

2.1.3.3 TRU Waste – Commingled PCB Waste

A small amount of TRU waste has sufficient concentrations of PCBs to make it subject to TSCA requirements. Most of the material is debris commingled with a small amount of PCBs, although some drums contain liquids with higher PCB content. Sludge from the K Basins is also TSCA regulated due to its PCB content, but is discussed separately in Section 2.1.3.7. At this time TSCA regulations require treatment of PCB wastes by incineration or other approved technology (40 CFR 761.60). TRU waste commingled with PCBs has not yet been approved for disposal at WIPP. However, DOE is preparing a permit application to allow disposal of this waste at WIPP. If WIPP is granted a permit to dispose of PCB-commingled waste, treatment may not be necessary for the debris materials. Liquid waste containing PCBs may still require thermal treatment or an approved alternative treatment before it could be accepted at WIPP. No capabilities currently exist on the Hanford Site to treat PCB waste. The wastes are expected to remain in storage in CWC until a treatment facility is available or until WIPP can accept such materials.

2.1.3.4 TRU Waste – Newly Generated and Existing CH Standard Containers

This waste stream includes CH TRU waste in standard containers stored in the CWC and future TRU waste that would be received in standard containers. This waste stream also includes the CH TRU waste that will be retrieved from the 618-10 and 618-11 burial grounds. The retrieved waste will be placed into standard containers including 208-L (55-gal) and 322-L (85-gal) drums and standard waste boxes (SWBs). The SWB is a metal box 181 cm (71 in) long, 94 cm (37 in) high, and 138 cm (54.5 in) wide that has been designed as a Type A shipping container for use in the TRUPACT-II shipping container. The waste would be inspected and certified at WRAP and would ultimately be shipped to the WIPP for disposal.

2.1.3.5 TRU Waste – Newly Generated and Existing CH Non-Standard Containers

This TRU waste is contained in non-standard boxes or containers that are not compatible with a TRUPACT-II shipping container and that cannot be handled within WRAP. Much of this waste is old equipment or gloveboxes that were removed from processing and laboratory facilities. Processing of this waste would likely include size reduction and repackaging. The Hanford Site does not currently have a facility where these wastes can be prepared for shipment to WIPP. Until they can be processed they will remain in the CWC.

2.1.3.6 TRU Waste – Newly Generated and Existing RH Containers

This TRU waste stream consists of existing and newly generated RH TRU waste, including a small quantity of waste that may be generated during retrieval from the 618-10 and 618-11 burial grounds. Existing RH TRU waste is shielded for storage in the CWC (see Section 2.2.1.1). The Hanford Site does not currently have a facility where RH TRU waste can be prepared for shipment to WIPP, nor are the WIPP waste acceptance criteria or shipping system in place. The RH TRU waste would be accepted at WIPP in accordance with the National TRU Waste Management Plan (DOE 2002a).

2.1.3.7 TRU Waste – K Basin Sludge

This sludge is a combination of corrosion debris from stored fuel elements and their containers, dust, and other materials that have accumulated in the 100 Area K Basins over many years of use. Because of the plutonium, fission product and activation product concentrations in the sludges, they have been determined to be RH TRU waste. In addition, the sludge is TSCA-regulated due to its PCB content. DOE plans to containerize the waste as it is removed from the basins and then transport it to the T Plant Complex for storage (DOE 2001b) until a facility is available to process the waste and prepare it for shipment to WIPP.

2.1.4 Waste Treatment Plant Wastes

The Waste Treatment Plant (WTP) will receive and process the retrieved Hanford tank waste. The retrieved tank waste will undergo a separations process that splits the waste stream into a smaller volume high-level waste (HLW) stream and a larger volume low-activity waste (LAW) stream. The HLW stream will be vitrified and placed into canisters that will be temporarily stored onsite in the Canister Storage Building and eventually sent offsite to the national geologic repository currently planned for Yucca Mountain. The processing of the wastes including their vitrification and the management of the HLW was previously evaluated in the TWRS EIS (DOE and Ecology 1996) and is not included in the scope of this EIS. For purposes of analysis in this EIS, the LAW stream also is assumed to be vitrified in the WTP. After vitrification, the LAW stream is called immobilized low-activity waste (ILAW). The melters used in the WTP for vitrification of both the HLW and LAW fractions will occasionally need to be replaced. These melters become their own waste stream called "WTP melters." Because the TWRS EIS has evaluated the processing of the glass, the HSW EIS addresses only the disposal of the ILAW and the WTP melters. It should be noted that the WTP will produce other LLW, MLLW, and TRU wastes that are included in the waste streams discussed in the previous sections.

2.1.4.1 Immobilized Low-Activity Waste Packages

During processing in the WTP, the molten ILAW can be directly poured into stainless steel canisters to produce a monolithic glass waste form, or it can be poured into water to produce waste in the form of granular glass particles similar to coarse sand, called cullet. The canisters for the monolithic glass waste form would be approximately 2.3 m (7.5 ft) in height and 1.22 m (4.0 ft) in diameter and would weigh up to 10,000 kg (22,000 lb) each when filled. An estimated 81,000 canisters would be filled using the monolithic pour compared to 140,000 canisters being filled with cullet. Dose rates from the cylinders are high enough (~500 mR/hr on contact) that remote handling will be required. The principal components in ILAW glass are silica, calcium oxide, and sodium oxide, making it a soda-lime silicate glass. Other waste forms are being considered for ILAW and are being analyzed in the Tank Closure EIS (68 FR 1052).

2.1.4.2 WTP Melters

The vitrification of both HLW and LAW wastes would use large melters composed of metal structural components and ceramic refractories to contain the molten glass. With use, the refractors are slowly consumed and some metal components can become corroded. Eventually it may be necessary to replace the melters with new units and the old melters will become a waste. Packages containing the melters can have dimensions of 4.6 to 7.6 m (15 to 25 ft) in length, height, and width; can weigh 545,000 kg (600 tons); and will require special handling.

2.2 Hanford Waste Storage, Treatment, and Disposal Facilities, and Transportation Capabilities Related to the Proposed Action

This section briefly describes existing and proposed facilities for the management of Hanford solid waste. The facilities provide storage, treatment, or disposal functions and are grouped by their primary function in the following discussion (see Figure 3.2 for facility locations). (See FH 2003 for additional details on specific facilities.) Text describing new facilities or those that would be substantially modified under the alternatives described in Section 3 is presented in text boxes to distinguish those facilities from existing facilities. This section also briefly discusses the transportation of waste and the Hanford pollution prevention/waste minimization program.

2.2.1 Storage Facilities

The primary storage facility for solid radioactive and mixed waste at Hanford is the CWC. Storage also exists at WRAP, the T Plant Complex, and the LLBGs. The T Plant Complex, described in Section 2.2.2.4 as a treatment facility, would be used to store sludge from the K Basins, and potentially other RH waste, as space is available. Trenches in the LLBGs have been used for retrievable storage of TRU wastes and other materials. Additional details on the CWC, trenches and caissons in the LLBGs, and grout vaults are described in the following sections.

Storage Facilities

Existing Facilities
- Central Waste Complex
- LLBGs
  – Trenches
  – Caissons
- T Plant Complex
- WRAP
- Modified Grout Vaults

Proposed New/Modified Facilities
Additional CWC Buildings

2.2.1.1 Central Waste Complex

The CWC is a series of handling areas, storage buildings, and storage modules that have been built in several phases for the receipt, inspection, storage, and limited treatment (that is, absorption and solidification of free liquids, neutralization of corrosive materials, and stabilization and encapsulation in solid waste matrixes) of wastes and materials awaiting verification, treatment, or disposal. The primary waste types of interest to the HSW EIS, with respect to storage, are MLLW and TRU waste, because most LLW is sent directly to burial. An aerial view of the CWC is shown in Figure 2.3. The Solid Waste Inventory Tracking System lists CWC inventory at the end of 2001 as a total of about 9200 m^3 (325,000 ft^3), composed mainly of MLLW 7350 m^3 (260,000 ft^3) and TRU waste 1560 m^3 (55,000 ft^3) (FH 2003). Its capacity is estimated to be 16,700 m^3 (589,000 ft^3). Most MLLW and TRU waste received since 1987 is now stored in the CWC, including TRU waste relocated from other facilities at Hanford. The CWC could be expanded as needed for future receipts of waste that require storage, including any retrievably stored waste removed from the LLBGs.

The CWC waste is segregated by content to assure compatibility of the contents of the various storage containers (for example, acidic and basic materials are stored separately). In addition to MLLW and TRU waste, some non-conforming LLW and GTC3 LLW may also be stored in CWC. All waste containers must be CH or shielded to CH levels to be accepted at CWC. Some RH waste is stored at CWC by shielding it to CH levels. Most of the waste is packaged in 208-L (55-gal) drums; however, other package sizes can also be stored.

Typically, four drums are banded onto a pallet to allow easy handling by forklifts and stacked up to three layers high. Aisles are provided to gain access to the drums for required routine visual inspections. See Figure 2.4. The packages have identifying numbers (bar codes) for tracking their location and contents. Waste remains within the CWC until it is shipped to other facilities for processing or disposal.

2.2.1.2 Retrievable Storage of Suspect TRU Waste in LLBG Trenches

Beginning in 1970, suspect TRU waste, primarily CH but also some RH waste, was placed in retrievable storage at the Hanford Site in specific trenches in Burial Grounds 218-W-3A, 218-W-4B,

M0212-0286.9A
HSW EIS 12-10-02

Figure 2.3. Aerial View of the Central Waste Complex

M0212-0286.9B
HSW EIS 12-10-02

Figure 2.4. Storage of Waste Drums in CWC

> ***Proposed New/Modified Storage Facility: Additional CWC Buildings***
>
> Additional storage buildings would be constructed at CWC as part of the No Action Alternative. The new buildings would be similar to the larger existing buildings. Each new building would be about 37 m (120 ft) wide by 55 m (180 ft) long by 6.1 m (20 ft) high to the eaves, and would hold about 4,600 208-L (55-gal) drums. The interior floors would be sloped with raised perimeter curbing to contain and direct spilled liquids to collection sumps. The floors would be sealed with impervious epoxy resins to reduce the impacts of any liquid spills.

218-W-4C, and 218-E-12B. From 1972 to 1973, drums of TRU waste were placed in a concrete V-trench (218-W-4B) with a metal cover. After 1974, drums and boxes were stored in trenches on either asphalt pads or plywood and covered with wood sheathing, tarps, and plastic. A layer of at least 1.2 m (4 ft) of earth was placed over the tarp cover. After 1985, most TRU waste was sent to an aboveground storage facility. However, small amounts of TRU waste have occasionally been added to the trench inventory. A small volume of this waste was never covered with dirt and has recently been removed from the trenches and placed in the CWC. About 14,600 m^3 (516,000 ft^3) of suspect TRU waste remain in the trenches (FH 2003).

2.2.1.3 Retrievable Storage of TRU Waste in LLBG Caissons

The waste caissons, designed to store RH waste, are reinforced cylindrical steel and concrete vaults 2.4 m (8 ft) in diameter and 3 m (10 ft) high. Four caissons have received TRU waste. These four caissons were buried in Trench 14 of Burial Ground 218-W-4B. The caissons have an offset connecting chute between the caisson and the soil surface to reduce radiation dose to workers as the waste was deposited. Gases from the caissons are passively filtered through high-efficiency particulate air (HEPA) filters. Caisson configuration is illustrated in Figure 2.5. Waste containers similar to 3.8-L and 18.9-L (1- and 5-gal) paint cans were dropped into the loading chute from a shielded shipment cask. Each caisson has been limited to a total plutonium-239 inventory equivalent of 5 kg (11 lb). Radiation levels in the caissons have been measured at 1500 to 10,000 R/hr (FH 2003).

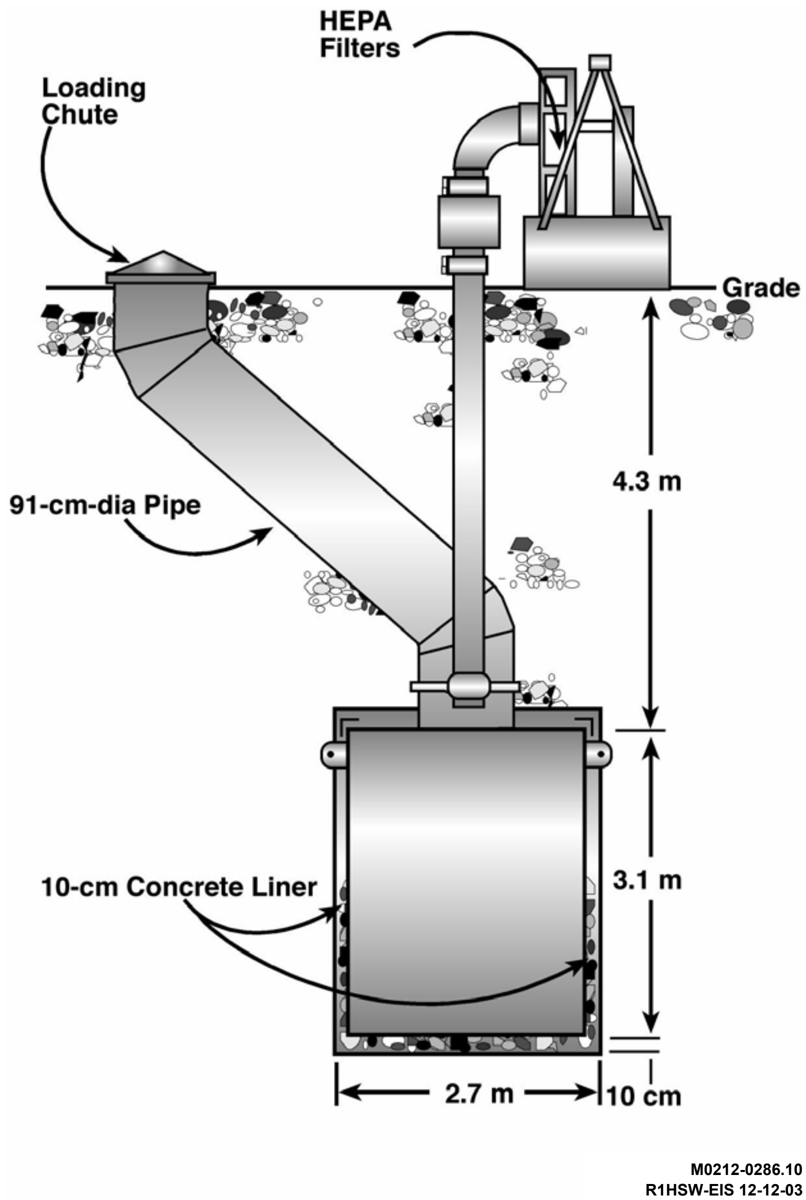


Figure 2.5. Schematic Drawing of RH TRU Caisson in the LLBGs

2.2.1.4 Interim Storage of ILAW in Grout Vaults

Grout vaults constructed in the 1980s would be used for interim storage of ILAW in the cullet form in the No Action Alternative. The existing vaults were designed to store low-activity tank waste in a grout-like form. Modifications to the vaults would be required before ILAW storage could take place. The modifications include excavation of surface materials, disassembly of vault covers, minor repairs to concrete surfaces and testing of leachate collection system, construction of superstructure over each vault to provide protection against wind and rain, and installation of additional leak detection monitoring. Once modifications are completed, ILAW canisters containing glass cullet form would be transported from WTP to the vaults via a tractor-trailer. A gantry crane would emplace the canisters. This process would continue until such time that new vaults could be constructed for disposal of the canisters. Then the canisters would be removed from the grout vaults and placed into the disposal vaults along with newly generated canisters.

2.2.2 Treatment and Processing Facilities

Treatment and processing facilities include those used to treat MLLW to applicable regulatory standards, as well as those where TRU waste is processed and certified for shipment to WIPP. DOE is currently using a combination of Hanford and offsite facilities to treat some CH MLLW and CH TRU waste. Commercial facilities have provided treatment capabilities for limited quantities of CH MLLW under two existing contracts. DOE does not currently have facilities for treatment of most CH MLLW, treatment of RH MLLW or TRU waste, or for non-standard containers of MLLW and TRU waste. The ETF provides treatment for leachate from the MLLW trenches. Cat 3 wastes are treated either by in-trench grouting or placement in HICs as discussed in Section 2.2.3.

Treatment and Processing Facilities

Existing Facilities
- WRAP
- T Plant Complex
- ETF
- Commercial Treatment Facilities
- In-Trench Grouting
- Other DOE sites

Proposed New/Modified Facilities
- Modified T Plant Complex
- New Waste Processing Facility
- Mobile TRU Processing Facility
- Pulse Driers
- Commercial Treatment Facilities

2.2.2.1 Waste Receiving and Processing Facility

The Waste Receiving and Processing Facility (WRAP) began operation in 1998 on the Hanford Site for management of TRU waste, MLLW, and LLW. The major function of WRAP is the inspection, repackaging, and certification of CH TRU waste to prepare it for transport and disposal at WIPP. The facility is also used to verify that incoming LLW meets HSSWAC, and to characterize MLLW for quality assurance purposes. A picture of WRAP is shown in Figure 2.6.

WRAP can accept CH drums and standard waste boxes. Handling of drums and boxes can be performed manually or by use of automated guided vehicles. WRAP provides the capability for non-destructive examination (NDE) and non-destructive assay (NDA) of incoming waste. The NDE is an X-ray process used to identify the physical contents of the waste containers in supporting waste characterization (see Figure 2.7). The NDA is a neutron or gamma energy assay system used to determine radionuclide content and distribution in waste packages.

M0212-0286.11
HSW EIS 12-10-02

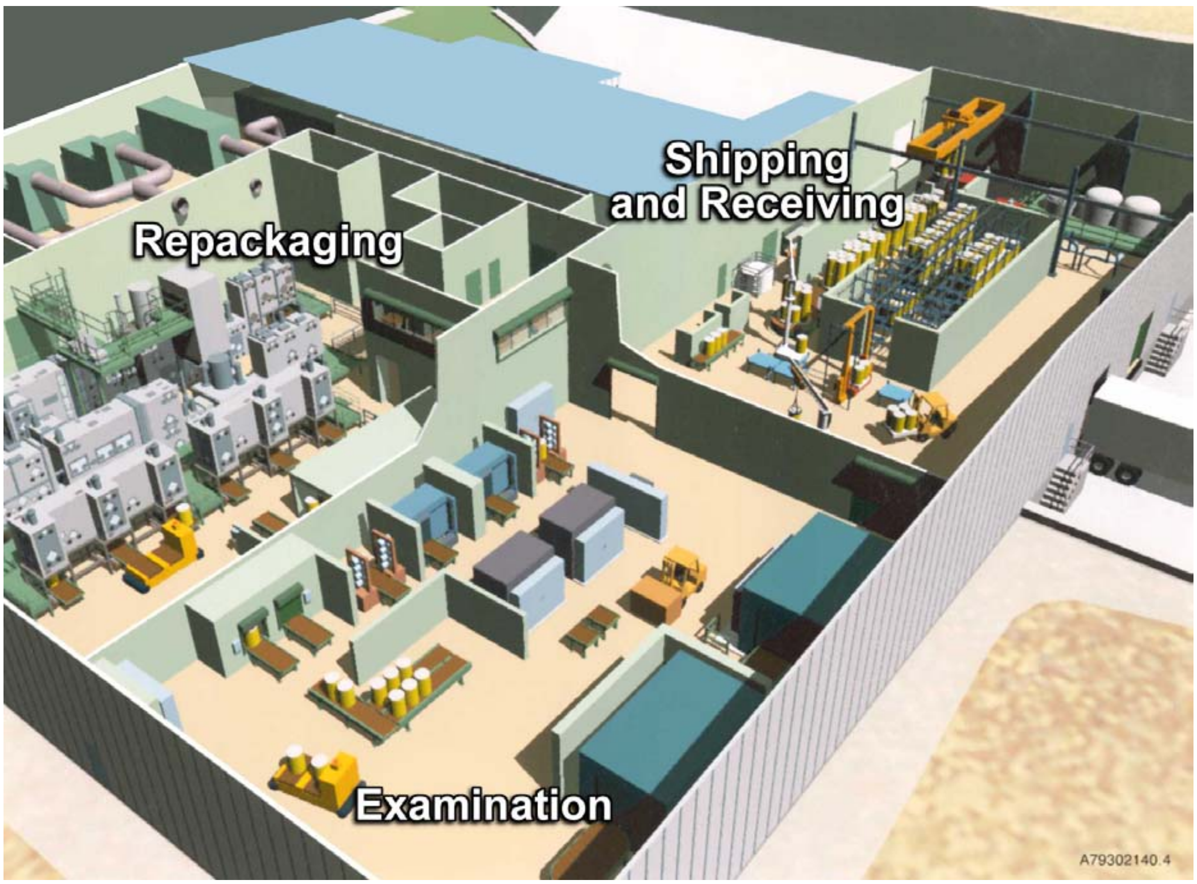
Figure 2.6. Waste Receiving and Processing Facility

M0212-0286.12
HSW EIS 12-10-02

Figure 2.7. X-Ray Image of Transuranic Waste Drum Contents

A layout for the 4806 m^2 (51,700 ft^2) facility is shown in Figure 2.8. The layout illustrates the major functions of shipping and receiving, examination, and repackaging within WRAP. Many operations at the facility, such as handling, opening, and processing waste packages, are conducted in gloveboxes or using automated equipment to minimize worker exposure to radioactive and hazardous materials. Certified CH TRU waste drums and standard waste boxes are loaded into TRUPACT-II shipping containers for transport from the facility to WIPP. Figure 2.9 shows the loading of a TRUPACT-II container in the WRAP.

WRAP also has limited treatment capabilities for TRU waste and MLLW by deactivation, solidification or absorption of liquids, neutralization of corrosives, amalgamation of mercury, microencapsulation, macroencapsulation, volume reduction by super compaction, stabilization of reactive waste, and repackaging waste as needed.



M0212-0286.13
HSW EIS 12-10-02

Figure 2.8. Layout for the Waste Receiving and Processing Facility

M0212-0286.14
HSW EIS 12-10-02

Figure 2.9. Transuranic Package Transporter-II Being Loaded in the Waste Receiving and Processing Facility

Proposed New/Modified Treatment Facility: Mobile TRU Processing Facility

Mobile TRU Processing Facilities or Accelerated Process Lines (APL) have been proposed for Hanford to accelerate the rate at which TRU waste can be certified and shipped to WIPP. The functions of the APLs are similar to functions in WRAP with capabilities to do NDA, NDE, headspace gas sampling, repackaging, and visual examination of the waste packages. The facilities will also have a loadout facility for TRUPACT-IIs. The facilities are expected to be developed in stages or modules so that the first module will process the standard 55-gal drums and a second module will process larger boxes. Two stage-one APLs are anticipated, each with a capacity to process about 2000 CH drums per year. It is anticipated that the headspace gas-sampling units will be inside one of the CWC buildings. Other units will be located outside but near the CWC buildings, on ground that has already been disturbed.

2.2.2.2 Commercial Treatment

Commercial treatment services have been used to treat some Hanford MLLW streams. These treatment capabilities consist of both non-thermal and thermal processes. Two contracts were placed with Allied Technology Group, Inc. (ATG) for thermal and non-thermal treatment of Hanford MLLW in a demonstration project beginning in 2000. Other commercial treatment contracts are being established by Hanford and through the broad spectrum contracts at Oak Ridge.

The non-thermal treatment contract provided for treatment of at least 1600 m^3 (56,500 ft^3) of MLLW and has been successfully completed and a new commercial contract has now been established for continued treatment of MLLW. The MLLW will largely consist of debris waste and will be treated principally by stabilization and macroencapsulation. Waste being macroencapsulated is shown in Figure 2.10. The local commercial treatment facility has some capability for physical extraction, neutralization, chemical oxidation, chemical reduction, microencapsulation, and deactivation. The local facility also has pretreatment capability for size reduction, drying, and sorting. The stabilization processes can be either cement or polymer based. Additional details on local commercial processes can be found in DOE 1998.

The thermal treatment contract was to begin in 2001 and provide processing of a minimum of 600 m^3 (21,200 ft^3) and a maximum of 3585 m^3 (126,600 ft^3) MLLW over a 5-year period. ATG planned to use a high-temperature plasma arc process to convert most organic contaminants to carbon dioxide and water (DOE 1999), however the unit experienced significant problems and has not been able to process the contracted volumes of waste and is no longer operating. At this point, the future of the thermal treatment unit remains uncertain. ATG has entered bankruptcy and the trustee in bankruptcy is seeking to sell the ATG Richland Operation.

M0212-0286.15
HSW EIS 12-10-02

Figure 2.10. Macroencapsulation of Mixed Low-Level Waste Debris at a Local Commercial Treatment Facility

Proposed New/Modified Treatment Facility: Commercial Treatment Facilities

Additional contracts with commercial treatment facilities would provide treatment for CH MLLW and non-conforming LLW. Thermal treatment capabilities are still needed and may be available in the future either locally or at other commercial facilities.

2.2.2.3 Leachate Treatment

Lined disposal facilities are required to incorporate a leachate collection system (WAC 173-303). The collection system retains rain and snowmelt that may contact waste and leach hazardous constituents from the waste. The leachate from onsite mixed waste trenches and future lined disposal facilities is collected and either sent to the 200 East Area Liquid Effluent Retention Facility (LERF) prior to treatment in the ETF or sent directly to ETF. Leachate is currently transported from lined disposal trenches by tanker truck. The ETF treats liquid waste using pH adjustment, filtration, ultraviolet light and peroxide destruction of organic materials, reverse osmosis, and ion exchange. The leachate to be treated at ETF is required to meet ETF waste acceptance criteria. The volume of leachate is expected to depend on the exposed surface area of the trenches.

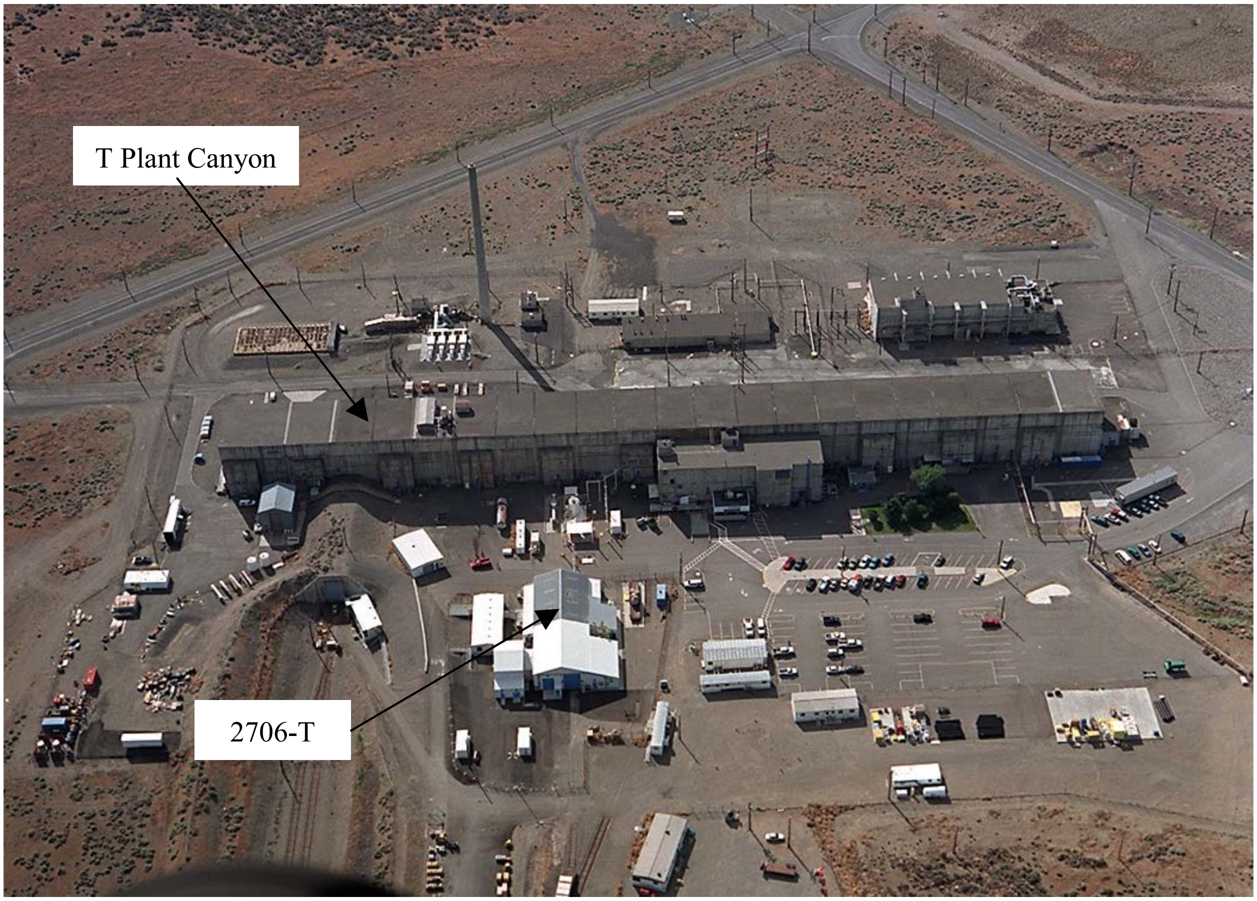
Proposed New/Modified Treatment Facility: ETF Replacement Capability

The ETF is scheduled to shut down at the end of 2025. After 2025 pulse driers would be used for leachate treatment. The pulse driers treat leachate by evaporation, leaving behind solids as secondary waste. These secondary wastes would be treated, as necessary, and disposed of in MLLW trenches as part of MLLW Action Alternatives. Depending on the amount of trench space available, these secondary wastes may be stored in CWC as part of the No Action Alternative.

2.2.2.4 T Plant Complex

The T Plant Complex consists of a number of buildings, as shown in Figure 2.11. The T Plant canyon and tunnel (221-T Building) are used for handling and processing of materials that require remote handling. Spent commercial reactor fuel and other RH wastes have been stored in the T Plant canyon. Dry decontamination, inspection, segregation, verification, and repacking of RH and large items are performed in the canyon. Current plans are to use the water-filled basin and refurbished process cells at T Plant to provide storage for the K Basin sludge (DOE 2001b). The sludge is expected to remain in the T Plant canyon until a treatment facility is available.

The T Plant canyon was built of reinforced concrete during 1943 and 1944 as a chemical reprocessing plant for defense program materials and was subsequently converted to decontamination and support functions in 1957. The building is 21 m (68 ft) wide, 259 m (850 ft) long, and 23 m (74 ft) high. The 37 cells within the building are designed to accommodate very high levels of radioactivity, and most cells have concrete shielding that is 2.1 m (7 ft) thick.



M0212-0286.16
HSW EIS 12-10-02

Figure 2.11. View of the T Plant Complex with 2706-T Facility and the T Plant Canyon Noted

Inspection, verification, opening, sampling, sorting, and limited treatment and repackaging of LLW, MLLW, and TRU waste are performed in the 2706-T Facility and other areas in the T Plant Complex. The 2706-T Facility, initially constructed during 1959 and 1960, was remodeled in 1998 to expand decontamination and treatment capabilities.

Proposed New/Modified Treatment Facility: Modified T Plant

In some MLLW alternatives and TRU waste alternatives, the T Plant Complex would be modified to establish the capabilities to treat/process waste for which no treatment capability currently exists. These waste streams include RH MLLW, MLLW in non-standard packages, RH TRU waste, CH TRU waste in non-standard containers, and PCB-commingled TRU waste. Specific capabilities provided by this modified T Plant would include stabilization, macroencapsulation, deactivation, sorting, sampling, repackaging NDE, and NDA.

MLLW would be treated to meet applicable regulatory requirements so that it can be disposed of in the MLLW trenches. TRU waste would be processed and shipped to WIPP.

Proposed New/Modified Treatment Facility: New Waste Processing Facility

As an alternative to modifying T Plant and using commercial contracts for MLLW and TRU waste treatment, a new facility would be constructed to process/treat the same waste streams and have all of the capabilities identified above for the modified T Plant Complex and for commercial treatment.

CH MLLW in standard containers, non-conforming LLW, elemental lead, and elemental mercury would also be treated in this new facility. Specific capabilities provided by the new facility to treat these waste streams could include stabilization, macroencapsulation, thermal desorption, mercury amalgamation, deactivation, sorting, sampling, repackaging, NDE, and NDA.

The new facility location is assumed to be in the 200 West Area near WRAP, consistent with previous DOE proposals for a modular complex to process MLLW and TRU waste. The new facility would be expected to be larger than WRAP (FH 2003).

MLLW would be treated to meet applicable regulatory requirements so that it can be disposed of in the MLLW trenches. TRU waste would be processed and shipped to WIPP.

2.2.3 Disposal Facilities

Disposal Facilities

Existing Facilities
- LLBGs
  – LLW Trenches
  – MLLW Trenches
- ERDF

Proposed New/Modified Facilities
- Existing Design Unlined LLW Trenches
- Deeper, Wider Unlined LLW Trenches
- Single Expandable Unlined LLW Trench
- Deeper, Wider Lined LLW Trenches
- Existing Design MLLW Trenches
- Deeper, Wider Lined MLLW Trenches
- Single Expandable Lined Trench
- Melter Trench
- ILAW Multiple Trenches
- ILAW Disposal Vaults
- ILAW Expandable Trench
- Modular Lined Combined Use Disposal Trenches
- Closure Caps

Facilities used for LLW and MLLW disposal at Hanford consist of the LLBGs and the Environmental Restoration Disposal Facility (ERDF). New or modified facilities would be developed for LLW, MLLW, ILAW, and WTP melters. Each of the existing and proposed new facilities considered in the alternatives is described in this section.

TRU wastes are disposed of in New Mexico at WIPP, which is the DOE repository for TRU wastes. Hanford began shipping TRU waste to WIPP in the summer of 2000 and would continue shipping TRU waste to WIPP for disposal.

LLW has been buried on the Hanford Site since the start of the defense materials production mission. Six LLBGs are located in the 200 West Area (218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, and 218-W-6) and two LLBGs are in the 200 East Area (218-E-10 and 218-E-12B). These eight disposal facilities are collectively referred to as the LLBGs. See Appendix D for additional information about each LLBG. The LLBGs have historically been used for temporary storage of some waste (these functions were previously described). Figure 2.12 shows a picture of a burial ground with both open and covered trenches.

M0212-0286.17
HSW EIS 12-10-02

Figure 2.12. Aerial View of a Low Level Burial Ground

The total volume of LLW placed in the LLBGs between 1962 and 1999 was about 283,000 m^3 (10,000,000 ft^3). The waste occupies an area of 141 ha (348 ac). The LLBGs occupy a total area of 425 ha (1050 ac); thus, approximately two-thirds of the LLBGs would be available for future waste disposal.

Within the LLBGs, several techniques can be used to provide extra confinement for Cat 3 LLW and approved GTC3 LLW. These techniques include placement of higher-activity LLW deep within the trench, burial in HICs, and in-trench grouting. The higher-activity LLW is usually placed in the bottom of the trenches with Cat 1 wastes placed on top of the Cat 3 and GTC3 LLW. This is intended to reduce the risk of intrusion into the higher-hazard wastes.

HICs are large cement boxes or cylinders into which the Cat 3 LLW and approved GTC3 LLW are placed for burial. The HIC is first placed within the burial trench and the waste is loaded into the HIC. Figure 2.13 shows four HICs in the bottom of a burial trench. The HIC is then sealed with a lid and buried with other LLW placed around it. The HIC provides additional containment for higher-activity waste while the radioactivity decays. The concrete used to construct the HICs also changes the chemistry of the soil in the immediate vicinity of the waste, which reduces the mobility of certain radionuclides.

M0212-0286.18
HSW EIS 12-10-02

Figure 2.13. High-Integrity Containers in a Low-Level Waste Disposal Trench

In-trench grouting involves placing the CH Cat 3 LLW and approved CH GTC3 LLW on a cement pad or on spacers, installing reinforcement steel and forms around the waste, and covering the waste with fresh concrete to encapsulate the waste within a concrete barrier. The process is limited to CH wastes because of the need for workers to be in close contact with the waste to place cement forms around them. Steel fibers are incorporated into the concrete to increase its strength. The resulting monoliths, such as the one shown in Figure 2.14, have a maximum size of 6.4 m (21 ft) long, 4 m (13 ft) high, and 2.7 m (9 ft) wide with a minimum wall thickness of 0.15 m (0.5 ft). After curing, the encased waste is covered with at least 2.4 m (8 ft) of soil. As with the HICs, in-trench grouting provides additional containment for the waste and retards migration of some radionuclides from the LLBGs. In-trench grouting is a more economical method for encapsulation of Cat 3 and GTC3 LLW than using the HIC.

The use of HICs versus in-trench grouting for CH waste is determined on a case-by-case basis. Generally, HICs are used for RH wastes while CH wastes are in-trench grouted. However, HICs can be used for either RH or CH waste.

The amount of waste that can be disposed of in a trench varies depending on the specific characteristics of the waste (e.g., CH vs. RH, Cat 1 vs. Cat 3) and how much cover soil is placed on the waste. Typically, about 30 percent to 50 percent of the total trench volume is filled with waste.

M0212-0286.19
HSW EIS 12-10-02

Figure 2.14. Trench Grouted Wastes

2.2.3.1 LLW Disposal Trenches

The existing LLW trenches currently comprise a series of relatively long, unlined, narrow trenches for disposal of LLW. The dimensions of existing trenches in the LLBGs vary with location. Typically, trenches are about 12 m (40 ft) wide at the base; however, some are "V" shaped and some are wider with flat bottoms. The trenches are excavated to a depth of approximately 6 m (20 ft). The waste is placed within the trenches and the location of each waste package is recorded in waste management records. Periodically the waste may be covered with dirt for interim periods before adding additional wastes. After the trenches are filled with waste to the desired level, a 2.6-m (8-ft) layer of soil is placed over the waste so the surface is near the original grade. The trenches are inspected weekly to note any areas of subsidence and when necessary corrective actions are taken in a timely manner. Layouts of the trenches within each LLBG are shown in Appendix D.

Proposed New/Modified Disposal Facility: Existing Design Unlined LLW Trenches

Trenches of the current design would be used to expand LLBG disposal capacity. Dimensions are nominally 12 m (39 ft) wide at the base, 6.1 m (20 ft) deep, 20 m (66 ft) wide on top, and 350 m (1150 ft) long. However, the dimensions of each trench are modified to fit within the available space of each specific burial ground. The number of new trenches would depend on the amount and category of LLW received.

Proposed New/Modified Disposal Facility: Deeper, Wider Unlined LLW Trenches

Deeper, wider LLW trenches would be used to expand LLBG disposal capacity. The reference design for deeper, wider LLW trenches was assumed to be 67 m (220 ft) wide at the top, 7 m (23 ft) wide at the bottom, about 18 m (60 ft) deep, and 350 m (1150 ft) long. However, the dimensions of each trench are modified to fit within the available space of each specific burial ground. The number of new trenches would depend on the amount and category of LLW received.

Proposed New/Modified Disposal Facility: Single Expandable Unlined LLW Trench

A single expandable unlined LLW trench would be used to expand disposal capacity for LLW. The trench would be similar to those for ERDF (see Section 2.2.3.3), except they would not contain any liners for leachate collection. It would also be constructed in the 200 W Area so that they could be expanded as needed for future wastes. The design of such a facility is in the earliest stage of conceptual design. The potential benefit of such a facility is economy of scale for construction and land use. The size of the trench would depend on the amount and category of LLW received. The trench would be about 18 to 21 m (60 to 70 ft) deep and would require 3.8 to 8.9 ha (1.5 to 3.6 ac).

2.2.3.2 MLLW Trenches

The two existing MLLW trenches (218-W-5, trenches 31 and 34) are located within a LLBG but, for the HSW EIS, they are considered separately from the other LLW disposal trenches. The trenches are permitted for MLLW disposal (DOE-RL 1997). One trench (see Figure 2.15) is currently being used as a MLLW disposal unit. The floor dimensions of the trenches are about 30.5 m (100 ft) wide by 76.2 m (250 ft) long and 9.1-10.7 m (30-35 ft) deep. The floor slopes to allow collection of leachate (rain or snow melt that has permeated through the waste). The surface dimensions are approximately 91 m (300 ft) wide by 137 m (450 ft) long and encompass approximately 1.3 ha (3.2 ac) of land.

Applicable regulations (WAC 173-303) require that waste trenches contain liners to collect any leachate that contacts the waste during the operating period. All liquids collected in the leachate collection system would be treated before disposal as discussed in Section 2.2.2.3. The existing MLLW trenches would be capped in accordance with applicable regulations.

M0212-0286.20
HSW EIS 12-10-02

Figure 2.15. Mixed Low-Level Waste Disposal Trench

Proposed New/Modified Disposal Facility: Existing Design MLLW Trenches

Additional trenches of the existing design would be needed. New MLLW trenches would be the same as those described above for the existing MLLW trenches. They would also be constructed in the 200 East Area to provide better access to ETF for leachate treatment. Regulations require that waste trenches contain liners to collect any leachate that contacts the waste during the operating period. All liquids collected in the leachate collection system would be treated before disposal. The trenches would be capped in accordance with applicable regulations.

Proposed New/Modified Disposal Facility: Deeper, Wider Lined MLLW Trenches

Deeper, wider trenches would be constructed to increase the efficiency and reduce the cost of future MLLW disposal at Hanford. They would also be constructed in the 200 East Area to provide better access to ETF for leachate treatment. The deeper, wider MLLW trench would be about 80 m (262 ft) wide as the base and 188 m (617 ft) wide at the top, with a depth of 18 m (60 ft). The length of the trench would be 170 m (558 ft) long for the Lower Bound volume and 340 m (1115 ft) long for the Upper Bound volume. Regulations require that waste trenches contain liners to collect any leachate that contacts the waste during the operating period. All liquids collected in the leachate collection system would be treated before disposal. The trenches would be capped in accordance with applicable regulations.

Proposed New/Modified Disposal Facility: Single Expandable Lined MLLW Trench

A single expandable lined trench would be used to expand disposal capacity for MLLW. It would also be constructed in the 200 East Area so that it could be expanded as needed for future wastes and have better access to ETF for leachate treatment. The design of such a trench is in the earliest stage of conceptualization. The potential benefit of such a trench is economy of scale for construction and land use. The size of the trench would depend on the future volume of MLLW to be disposed of. The trench would be about 18 to 21 m (60 to 70 ft) deep and would require 3.8 to 8.9 ha (1.5 to 3.6 ac).

Proposed New/Modified Disposal Facility: Lined Melter Trench

The vitrification of tank waste on the Hanford Site would result in the need to dispose of WTP melters. These items would be treated at the vitrification facility to ready them for disposal. The large melters would be taken to a lined trench designed for them. The dimensions for the melter trench would be about: 270 m (886 ft) long, 120 m (165 ft) wide, and 21 m (70 ft) deep. To place the melters into the trench a ramp with a 6 percent grade into the trench is planned. Leachate from the melter trench would be treated along with other MLLW trench leachate. The trench would be capped in accordance with applicable regulations.

2.2.3.3 ILAW Disposal Facilities

See the following text boxes for a description of the proposed ILAW disposal facilities.

Proposed New/Modified Disposal Facility: ILAW Disposal in an Expandable Trench

ILAW would be disposed in a single expandable trench located in the 200 East Area just southwest of the PUREX facility. A single trench 183 m wide by 365 m long by 10 m deep could accommodate the total mission quantity of ILAW (Aromi and Freeberg 2002). The bottom of the trench would contain a double leachate collection system similar to a RCRA Subtitle C landfill.

Initially two cells, each 62 m wide by 76 m long, would be installed. These cells could accommodate about 22,000 ILAW packages (Aromi and Freeberg 2002). Additional cells would be installed as necessary to accommodate the ILAW.

The canisters would be emplaced by a crane. The crane would be equipped with instrumentation and controls to allow the logging of each canisters position, serial number, and date using a GPS.

After several canisters are emplaced, the crane operator, using a material-handling bucket, will place fill between and over the canisters, thereby minimizing the overall radiation exposure to the crane operator.

Proposed New/Modified Disposal Facility: ILAW Disposal in Multiple Trenches

The current design for each monolithic ILAW canister disposal trench is for a bottom dimension of 20 m (66 ft) by 210 m (690 ft). The trenches would be 10 m (33 ft) in depth with a top dimension of 80 (300 ft) by 280 m (920 ft) with 3:1 side slopes. The bottom of the trench would contain a double leachate collection system similar to a RCRA Subtitle C landfill (Burbank 2002).

The monolithic ILAW canisters would be removed from the transport vehicles using a large crane with a 90-m (300-ft) boom and a 22-metric ton (25-ton) capacity at 85 m (280 ft). The crane would be equipped with instrumentation and controls to allow the logging of each canister's position, serial number, and date using a global positioning system (GPS). This information would be relayed to the support facility for real-time readout and tracking of all canisters placed.

After several canisters are emplaced, the crane operator, using a material handling bucket, would place fill between and over the canisters, thereby minimizing the overall radiation exposure to the crane operator. Final cover of each layer to provide 1 m (3 ft) compacted cover would be completed by standard heavy earthmoving equipment.

Three layers of canisters would be placed into each trench with the first layer containing approximately 1,900 canisters; the second layer containing approximately 4,500 canisters; and the third layer containing approximately 7,300 canisters. The total capacity of each trench would be approximately 13,700 canisters (Burbank 2002).

An interim barrier would be placed atop each trench as it is filled. The first layer is backfill, which would vary in thickness with a minimum depth of 1.3 m (4.3 ft) and would provide a slope of not greater than 2 percent from the center of the trench to the outer edges. To minimize leachate collection, a temporary weather barrier, 'rain cover' or surface liner would be placed on top of this slope as part of operations activities. As the final closure activities would not occur for several years following filling of a trench, an interim cover consisting of two layers of sand and gravel would be placed as part of the operations activities. This interim cover would be a minimum of 2 m (7 ft) in thickness to provide additional protection from water intrusion. The trenches would be capped in accordance with applicable regulations.

Proposed New/Modified Disposal Facility: ILAW Disposal Vaults

Under the No Action Alternative 66 new vaults would be constructed onsite for the disposal of the ILAW cullet. Each vault would be an estimated 37 m (120 ft) long by 10 m (33 ft) wide by 15 m (50 ft) deep with a capacity to hold 5,300 m^3 (7,000 yd^3) of ILAW (DOE 2001c). These vaults would contain a leachate collection system and an array of monitoring wells. The canisters would be emplaced by a gantry crane. The crane would be equipped with instrumentation and controls to allow the logging of each canisters position, serial number, and date using a GPS. An interim barrier would be placed atop each vault as they are filled. The interim barrier would consist of backfill of variable thickness but a minimum depth of 1.3 m (4.3 ft). The interim barrier would also contain a temporary surface liner and an interim cover of sand and gravel atop the backfill. The total thickness of the interim barrier would be at least 3.3 m (11 ft).

2.2.3.4 Environmental Restoration Disposal Facility

ERDF, which began operation in 1996, is located in the center of the Hanford Site between the 200 East and 200 West Areas. ERDF is a large-scale, evolving landfill, complete with ancillary facilities as shown in Figure 2.16. It is designed to receive and isolate low-level radioactive, hazardous and mixed wastes. ERDF is a RCRA- and TSCA-compliant landfill authorized under CERCLA. The facility complies with all substantive elements of applicable or relevant and appropriate requirements identified through the CERCLA process, including Washington State and EPA codes, standards, and regulations, as well as with DOE orders. Administrative requirements such as RCRA permitting are not required for disposal of CERCLA waste from Hanford cleanup actions.

M0212-0286.686
HSW EIS 02-20-03

Figure 2.16. Environmental Restoration Disposal Facility (ERDF)

Four disposal cells currently make up ERDF. The first two cells are each 21 m (70 ft) deep, 152 m (500 ft) long, and 152 m (500 ft) wide at the bottom and were completed in 1996. Construction of two additional cells of the same size was completed in 2000. Two additional cells are currently under construction. An interim cover was placed over the filled portions of the first two cells. Design and construction of the final cover will not begin until cells #3 and #4 are filled. ERDF can be expanded further if necessary. It is authorized to be expanded up to eight cells. Capacity of the current four-cell configuration is 4.7 billion kg (5.2 million tons).

The cells are lined with a RCRA Subtitle C-type liner, and have a leachate collection system. The facility is monitored regularly and when closed will continue to be monitored to ensure that human health and the environment are protected.

ERDF is designed to provide disposal capacity, as needed, to accommodate projected Hanford waste volumes over the next 20 to 30 years. It is being included in this EIS as an alternative disposal site to the LLBGs.

Proposed New/Modified Disposal Facility: Modular Lined Combined Use Disposal Facility

A Modular Lined Combined Use Disposal Facility is similar in configuration and size to ERDF. The facility could involve three different configurations. The first and most comprehensive would include LLW, MLLW, melters, and ILAW (Aromi and Freeberg 2002). The second would include only LLW and MLLW, and the third would include only melters and ILAW. Several locations have been considered for the facility including near PUREX, so as to be close to the WTP, near the existing LLBGs in 200 East, and at ERDF. As with other disposal facilities, it would be capped in accordance with applicable regulations.

2.2.3.5 Liners for Waste Disposal Facilities

DOE currently has three double-lined facilities on the Hanford Site: ERDF, two RCRA-permitted mixed waste trenches, and three RCRA-permitted, liquid waste surface impoundments called the Liquid Effluent Retention Facility (not part of the HSW EIS scope). The RCRA-compliant waste disposal cells liner system consists of series of layers as shown in Figure 2.17. Additional liner technologies are discussed in Appendix D.

The geotextile layers provide a filtration/separation medium when placed adjacent to the sub-grade and between the geomembrane and the leachate collection system's layers. The geomembrane is to prevent the downward movement of contaminants. During liner installation, great care is taken to avoid mechanical tearing of the liner material and generally, a very comprehensive onsite liner system installation Quality Assurance Program is followed to ensure the integrity and longevity of the liner system.

Polyethylene geomembranes provide a highly impermeable barrier to gasses and liquids in order to mitigate or eliminate ground water contamination. The high-density polyethylene (HDPE) geomembranes are resistant to corrosion and most chemicals, resistant to biological degradation, and resistant to ultra-violet light degradation. They are also flexible, thereby permitting ground movement and contraction and swelling due to temperature fluctuations without cracking and unaffected by wet/dry cycle (unlike bentonite clays).

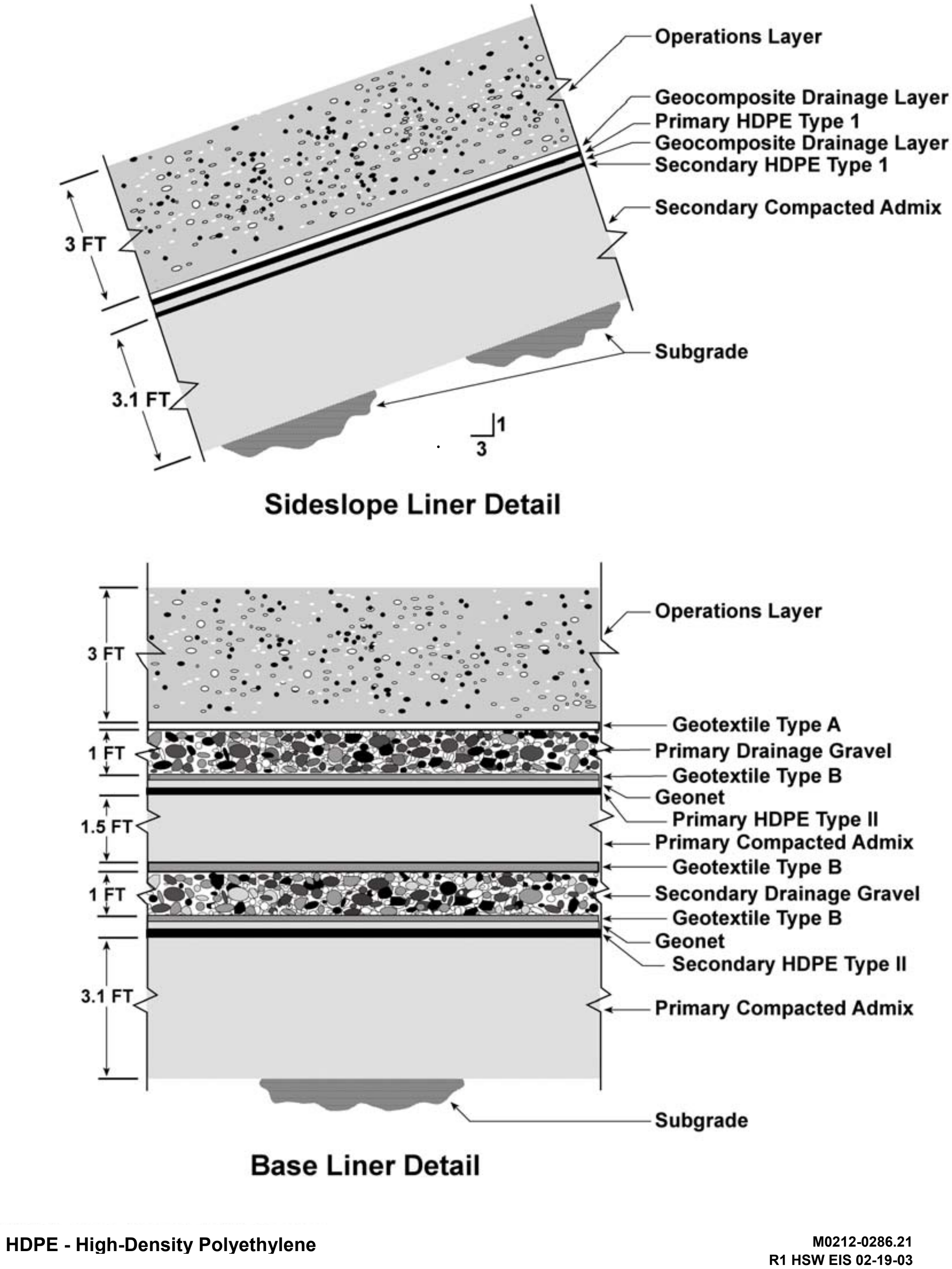


Figure 2.17. Typical Liner System

M0212 0286-21
R1 HSW EIS 02-19-03

HDPE is chemically resistant because it is essentially inert, and because of its high density and resultant low permeability, it resists penetration by chemicals. Chemicals that do react with HDPE are primarily oxidizing agents like nitric acid and hydrogen peroxide. Oxidation will only occur under two conditions: 1) the oxidizer must be in high concentrations, and 2) the material must receive a sufficient supply of energy to activate the reaction (Tisinger and Giroud 1993). If oxidation does occur, the HDPE material becomes soft and brittle and therefore becomes subject to stress cracking. Under anaerobic conditions or conditions devoid of energy, oxidation cannot occur. Because most waste facilities are typically anaerobic and the liner is buried and therefore not directly exposed to the sunlight, the process of oxidative degradation of HDPE liners is highly unlikely. Furthermore, most HDPE liners contain antioxidants that further mitigate the impacts of oxidation on liner degradation.

2.2.3.6 Closure Barriers

Closure barriers (also know as "caps") are planned for the disposal trenches in accordance with applicable regulations. Because the design and timing of the barriers is still being decided, the various design options are still being considered. For the EIS analysis the Modified RCRA Subtitle C barrier was selected. Other closure barrier designs are described in Appendix D.

The Modified RCRA Subtitle C barrier is designed to provide long-term containment and hydrologic protection for a performance period of 500 years with no maintenance being conducted after an assumed 100-year institutional control period. The performance period is based on radionuclide concentration and activity limits for Cat 3 LLW. The Modified RCRA Subtitle C Barrier, shown in Figure 2.18, is composed of eight layers of durable material with a combined minimum thickness of 1.7 m (5.5 ft) excluding the grading fill layer. This design incorporates *Resource Conservation and Recovery Act of* 1976 "minimum technology guidance" (MTG) (EPA 1989), with modifications for extended performance. One major change is the elimination of the clay layer, which may desiccate and crack over time in an arid environment. The geo-membrane component has also been eliminated because of its uncertain long-term durability. The design also incorporates provisions for bio-intrusion and human intrusion control.

A borrow pit to supply the local materials for the barriers would be developed at Areas B and C in accordance with the discussion in Appendix D.

Proposed New/Modified Disposal Facility: LLBG Closure Barrier or Cap

MLLW trenches are capped in accordance with applicable regulations. The LLBGs would be closed and capped beginning in 2046. While the final design for the closure cap or barrier has not yet been decided, the RCRA modified Subtitle C Barrier illustrated in Figure 2.18 has been used for the HSW EIS analysis. Alternative barrier designs are discussed in Appendix D. A discussion of the borrow pits in Areas B and C that are assumed to be used to derive some of the capping material is contained in Appendix D.

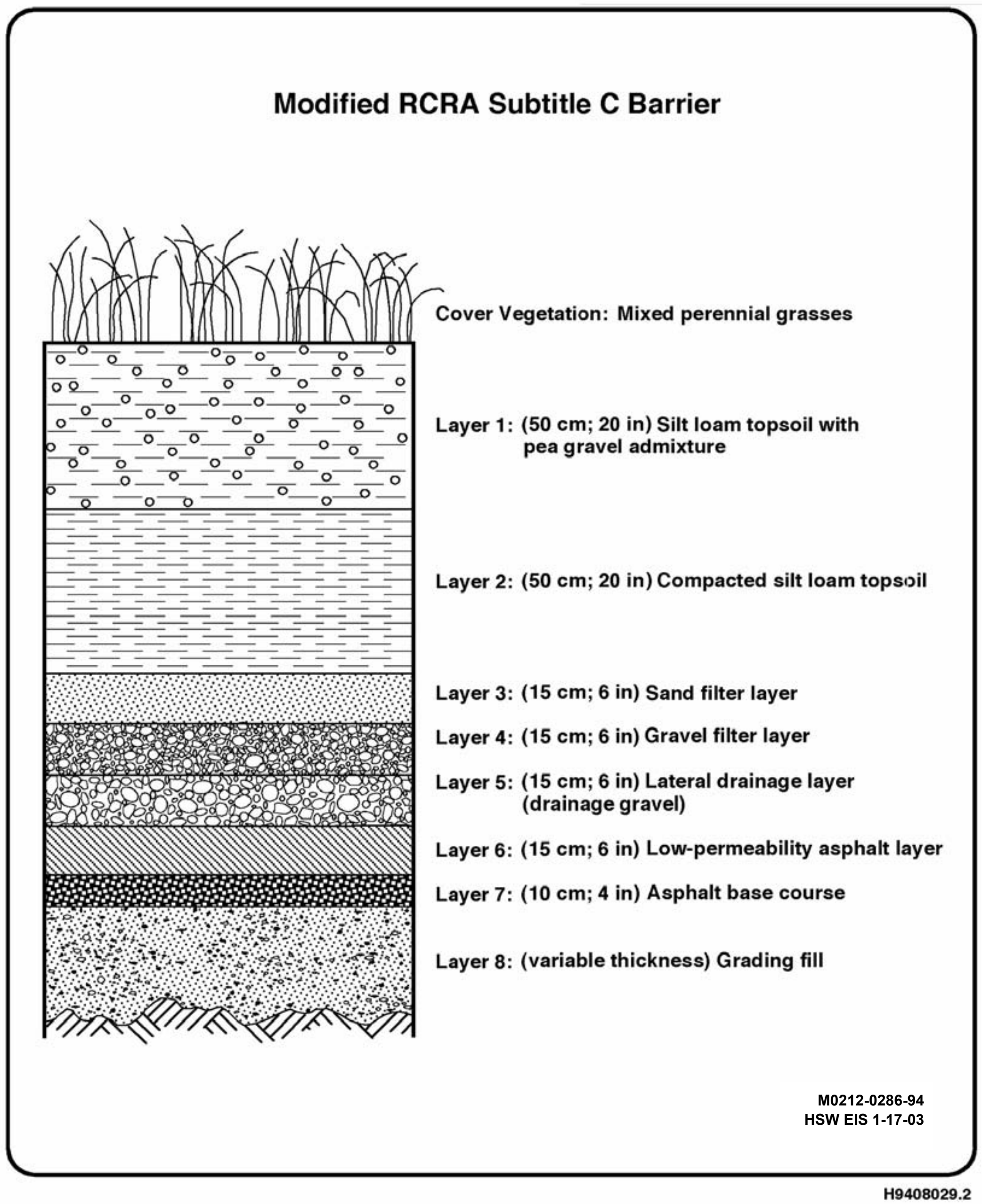


Figure 2.18. Modified RCRA Subtitle C Barrier for Mixed Low-Level Waste Trenches and the Low Level Burial Grounds

2.2.4 Transportation

Solid radioactive waste is currently transported on the Hanford Site by truck. The site has reactivated its rail system. DOE is considering shipping TRU waste to WIPP by rail, if rail shipments become practical. LLW and MLLW could be received by rail from offsite generators. Shipment of waste by rail may require constructing a spur or developing intermodal transfer capability from the existing rail lines, and if such construction and capability is proposed it will be evaluated under future NEPA reviews. Section 4.8.5 provides additional information on the Hanford transportation system features.

2.2.4.1 Transportation Overview

About 300 million hazardous material[(a)] shipments (DOT 1998) occur in the United States every year. About 3 million (1 percent) of these involve shipments of radioactive material.[(b)] Currently, less than one percent of these 3 million radioactive material shipments are DOE shipments (NEI 2003). The number of LLW and MLLW shipments is expected to rise over the next five years. The number of shipments expected to go to Hanford related to the proposed action is addressed in Section 5.8 as part of the environmental impacts analysis. The annual peak of all DOE radioactive material shipments is expected to be larger due to HLW, TRU waste, and spent nuclear fuel shipments and due to acceleration of cleanup activities. However, acceleration of cleanup activities would not change the total number of shipments. In addition, the annual number of DOE radioactive material shipments will continue to be small in comparison to the total number of hazardous material shipments nationwide.

Even though the number of DOE shipments will continue to be relatively small, DOE shipments will represent a large amount of the radioactivity being shipped. Of DOE's radioactive materials, LLW, MLLW, and TRU waste will account for about 90 percent by volume, but less than 6 percent by radioactivity. The bulk of the radioactivity is in HLW and SNF.

2.2.4.2 Transportation Regulations

Shipment of hazardous materials is regulated by the U.S. Department of Transportation (DOT). The DOT regulations for shipping hazardous materials can be found in the Hazardous Material Regulations (49 CFR 106-180), the Federal Motor Carrier Safety Regulations (49 CFR 390-397), and Packaging and Transportation of Radioactive Material (10 CFR 71). Other regulations and requirements for the shipment of radioactive materials can be found in DOE's Radioactive Material Transportation Practices (DOE 2002b).

These regulations address many specific subjects including:

- shipper and carrier responsibilities
- planning information

(a) For the purposes of this transportation discussion, hazardous materials include items that present chemical hazards, radioactive hazards, and physical hazards (e.g., compressed gases).

(b) Radioactive materials include radioactive waste.

- routing and route selection
- notifications
- shipping papers
- driver qualifications and training
- vehicles and required equipment
- equipment inspections
- labeling (information on containers)
- placarding (information on the shipping vehicle)
- emergency planning
- emergency notification
- emergency response
- security.

States have also established regulations consistent with DOT regulation. These regulations vary from state to state and typically address permitting, licensing, notification, determination of routes, financial liability, and inspection. Many states require transportation permits for radioactive materials. Some examples of state regulations can be found in:

- Oregon Administrative Rule 740-100, Vehicles: Driver: Equipment: Equipment Required and Condition of Vehicles (OAR 740-100)

- Oregon Administrative Rule 740-110, Transportation of Hazardous Materials (OAR 740-110)

- WAC 246-231, Packaging and Transportation of Radioactive Materials

- WAC 446-50, Transportation of Hazardous Materials.

Packaging – The type of package required depends, in part, on the total quantity of radioactivity, the form of the materials, and the concentration of radioactivity. DOE is responsible for determining the appropriate container for the material it is transporting. DOE ensures that each package containing hazardous materials meets DOT regulations for design, material, manufacturing methods, minimum thickness, tolerance, and testing.

Labeling and Placarding – Labels are required on each container to indicate the type of hazard contained in each container. Placards are used on vehicles transporting hazardous materials to indicate the type of hazard being transported. Labels and placards are used, in part, to help emergency responders in case of an accident.

Driver Qualifications – Drivers of all hazardous materials, including radioactive materials, must be trained in accordance with DOT regulations. Most radioactive waste shipments require specific driver training on emergency response appropriate for the materials being carried.

Routing – In general, the carrier selects the shipping routes for highway shipments of most hazardous materials in accordance with DOT regulations. Routes are selected to minimize risk with consideration to such factors as distance of shipment, accident rates, time in transit, population density, time of day, and day of the week. Most radioactive waste is transported along the interstate highway system.

Notification – DOE notifies affected states regarding shipments of spent nuclear fuel, HLW, and TRU waste. States are generally not notified about shipments of LLW and MLLW. DOE does not notify states about shipments of classified materials. When notifications are made to states, they are usually also made to affected tribal authorities.

Emergency Preparedness – Local, state, tribal, and federal governments and carriers all have responsibility for preparing for and responding to transportation emergencies.

Local or tribal personnel typically are the first responders and incident commanders for offsite transportation accidents. Although many local jurisdictions have special hazardous material response units, most seek state or federal technical assistance during radiological incidents.

State and tribal governments have primary responsibility for the health and welfare of their citizens and therefore have an interest in ensuring the safety of shipments of hazardous materials, including DOE-owned materials, within their boundaries. Some states maintain specialized emergency response units capable of responding to radioactive material incidents in support of local authorities.

The Federal Emergency Management Agency (FEMA) is responsible for the federal government's emergency response activities. These activities are coordinated through a Federal Radiological Emergency Response Plan developed by FEMA and 11 other federal agencies. FEMA also provides assistance and evaluates state and local preparedness for radiological emergencies.

DOT has established requirements for reporting transportation accidents involving radioactive materials and has a comprehensive training program on handling emergencies involving radioactive materials shipments.

Carriers are required to notify the National Response Center (operated by the U.S. Coast Guard) of all releases of hazardous substances that exceed reportable quantities or levels of concern. Certain transportation incidents involving hazardous materials must also be reported to the National Response Center immediately including those where

- a person is killed
- a person receives injuries that require hospitalization
- property damage exceeds $50,000
- radioactive materials are released
- major roads are closed.

The DOE manual (DOE 2002b) expands these criteria and requires notification to the states.

DOE operates a Radiological Assistance Program (RAP) with eight Regional Coordinating Offices staffed with experts available for immediate assistance in offsite radiological monitoring and assessment. DOE RAP teams assist state, local, and tribal officials in identifying the material and monitoring to determine if there is a release and with general support.

Consistent with the DOE manual (DOE 2002b), DOE has developed the Transportation Emergency Preparedness Program to assist federal, state, tribal, and local authorities to prepare for transportation accidents involving radioactive materials. That assistance includes planning for emergencies as well as training for emergencies. For example, through education programs offered to state and tribal organizations, over 17,000 emergency response personnel in twenty states have been trained to respond to accidents involving radioactive material (Westinghouse 2001).

Like private-sector shippers, DOE must provide emergency response information required on shipping papers, including a 24-hour emergency telephone number. Shippers have overall responsibility for providing adequate technical assistance for emergency response.

Carriers are required to provide emergency planning, emergency response assistance, liability coverage, and site cleanup and restoration. DOE's policy is to respond to requests for technical advice with appropriate information and resources.

Specific information regarding local emergency preparedness can be found through Local Emergency Planning Committees (LEPCs) or State Emergency Response Commissions (SERCs).

2.2.5 Pollution Prevention/Waste Minimization

Consistent with the requirements and guidance of several laws and executive orders, including the Pollution Prevention Act of 1990 (42 USC 13101), DOE performs pollution prevention and waste minimization activities in the work it does. Pollution prevention is defined as the use of materials, processes, and practices that reduce or eliminate the generation and release of pollutants, contaminants, hazardous substances, and wastes into land, water, and air. Pollution prevention includes practices that reduce the use of hazardous materials, energy, water, and other resources along with practices that protect natural resources through conservation or more efficient use. Within DOE, pollution prevention includes all aspects of source reduction as defined by the EPA, and incorporates waste minimization by expanding beyond the EPA definition of pollution prevention to include recycling.

Pollution prevention is achieved through:

- equipment or technology selection or modification, process or procedure modification, reformulation or redesign of products, substitution of raw material, waste segregation, and improvements in housekeeping, maintenance, training or inventory control

- increased efficiency in the use of raw materials, energy, water, or other resources

- recycling to reduce the amount of waste and pollutants destined for release, treatment, storage, and disposal.

Pollution prevention is applied to all DOE pollution-generating activities including:

- manufacturing and production operations
- facility operations, maintenance, and transportation
- laboratory research
- research, development, and demonstration,
- weapons dismantlement
- stabilization, deactivation, and decommissioning
- legacy waste and contaminated site cleanup.

2.2.6 Decontamination and Decommissioning of Hanford Facilities

Decontamination is the removal, by chemical or physical methods, of radioactive or hazardous materials from internal and external surfaces of components, systems and structures in a nuclear facility. It is usually the first step toward decommissioning. Decommissioning of a nuclear facility can be defined as the measures taken at the end of the facility's lifetime to assure protection of public health and safety and the environment. Such measures can involve protective storage, entombment, or removal. For protective storage, the facility is left intact after removal of most of the radioactive materials and the appropriate security controls are established to assure public health and safety. Entombment consists of removing radioactive liquids and wastes and then sealing all remaining radioactivity within the facility and then establishing appropriate security controls to assure public health and safety. For the removal option, all radioactive materials are removed from the site and the facility is refitted for other use or completely dismantled.

2.2.7 Long-Term Stewardship

The Hanford Site is being cleaned up to meet certain land-use requirements. These requirements are based, in part, on limitations of what level of cleanup can be practically achieved. Limitations that prevent unrestricted use of all land and groundwater at the Hanford site include:

- technical and economic limitations – technically or economically practicable technology does not exist to perform cleanup activities. For example, no technology, known or anticipated, can remove 100% of the contents of Hanford's high-level waste tanks.

- worker safety and health issues – impacts to workers from cleaning up may be greater than the impacts to the general public for not cleaning up. For example, the impacts to workers from digging up and treating waste from old burial grounds might be greater than the impacts to the general public from capping the waste in place.

- environmental issues – cleanup may result in greater impacts to the environment than already exist. For example, the risk of accidental releases to the environment during retrieval of waste from old burial grounds might be larger than the risk to the environment from capping the waste in place.

These limitations result in some hazards remaining after cleanup activities are complete. Since some hazards will remain, continued efforts are needed to monitor the hazards and deal with any problems that occur. These post-cleanup activities are referred to as long-term stewardship.

Specific long-term stewardship activities are dependent on rules and regulations under which the specific cleanup and post-cleanup activities are performed and the specific hazards that remain. Long-term stewardship activities are intended to continue isolating hazards from people and the environment. Specific long-term stewardship activities can include:

- monitoring to verify the integrity of caps placed over disposal sites
- maintaining caps to ensure their continued integrity
- monitoring groundwater and the vadose zone to determine whether systems to contain hazards are performing as expected
- monitoring for surface contamination
- monitoring animals, plants, and the ecosystem
- performing groundwater pump-and-treatment operations
- installing and maintaining fences and other barriers
- posting warning signs
- establishing easements and deed restrictions
- establishing zoning and land use restrictions
- maintaining records on clean up activities, remaining hazards, and locations of the hazards
- providing funding and infrastructure (e.g., utilities, roads, communication systems)

2.3 References

10 CFR 61.55. "Licensing Requirements for Land Disposal of Radioactive Waste." U.S. Code of Federal Regulations. Online at: http://www.access.gpo.gov/nara/cfr/waisidx_01/10cfr61_01.html.

10 CFR 71. "Packaging and Transportation of Radioactive Material." U.S. Code of Federal Regulations. Online at: http://www.access.gpo.gov/nara/cfr/waisidx_01/10cfr71_01.html.

10 CFR 962. "Byproduct Material." U.S. Code of Federal Regulations. Online at: http://www.access.gpo.gov/nara/cfr/waisidx_02/10cfr962_02.html.

40 CFR 761. "Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution In Commerce, and Use Prohibitions." U.S. Code of Federal Regulations. Online at: http://www.access.gpo.gov/nara/cfr/waisidx_01/40cfr761_01.html.

49 CFR 106-180. “Rulemaking Procedures” through “Continuing Qualification and Maintenance of Packagings.” U.S. Code of Federal Regulations. Online at: http://www.access.gpo.gov/nara/cfr/waisidx_01/49cfrv2_01.html.

49 CFR 390-397. “Federal Motor Carrier Safety Regulations.” Online at: http://www.access.gpo.gov/nara/cfr/waisidx_01/49cfr390_01.html.

53 FR 12449. “Disposal of Hanford Defense High-Level, Transuranic and Tank Wastes, Hanford Site, Richland, Washington; Record of Decision (ROD).” *Federal Register* (April 14, 1988).

68 FR 1052. “Notice of Intent To Prepare an Environmental Impact Statement for Retrieval, Treatment, and Disposal of Tank Waste and Closure of Single- Shell Tanks at the Hanford Site, Richland, WA.” *Federal Register* (January 8, 2003).

15 USC 2601, et seq. Toxic Substances Control Act (TSCA). Online at: http://www4.law.cornell.edu/uscode/15/2601.html.

42 USC 4321 et seq. National Environmental Policy Act (NEPA) of 1969, as amended. Online at: http://www4.law.cornell.edu.

42 USC 6901, et seq. Resource Conservation and Recovery Act (RCRA) of 1976. Online at: http://www4.law.cornell.edu/uscode/42/6901.html.

42 USC 13101. Pollution Prevention Act of 1990. U.S. Code of Federal Regulations. Online at: http://www4.law.cornell.edu.

Anderson, B. C., J. D. Anderson, J. A. Demiter, D. R. Duncan, and D. C. McCann. 1990. Contact-Handled Transuranic Waste Characterization Based on Existing Records. WHC-EP-0225, Westinghouse Hanford Company, Richland, Washington.

Aromi, E. S. and R. D. Freeberg. 2002. *Request for CHG Support Concerning Immobilized Low-Activity Waste Choices*. CHG-0203620R2, CH2M Hill Hanford Group, Richland, Washington.

Burbank, D. A. 2002. *Conceptual Design Report for Immobilized Low-Activity Waste Disposal Facility, Project W-520, Rev 0*). RPP-7908, Rev. 0A, CH2M Hill Hanford Group, Richland, Washington.

DOE. 1987. *Final Environmental Impact Statement for Disposal of Hanford Defense High-Level, Transuranic, and Tank Wastes*. DOE/EIS-0113, U.S. Department of Energy, Washington D.C.

DOE. 1997a. *Final Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*. DOE/EIS-0200-F, U.S. Department of Energy, Washington, D.C.

DOE. 1997b. *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement.* DOE/EIS-0026-S-2, U.S. Department of Energy, Carlsbad Area Office, Carlsbad, New Mexico.

DOE. 1998. *Environmental Assessment for Non-Thermal Treatment of Hanford Site Low-Level Mixed Waste*. DOE/EA-1189, U.S. Department of Energy, Richland Operations Office, Richland, Washington. Online at: http://www.hanford.gov/docs/ea/ea1189/index.html.

DOE. 1999. *Environmental Assessment Offsite Thermal Treatment of Low-Level Mixed Waste*. DOE/EA-1135, U.S. Department of Energy-Richland Operations Office, Richland, Washington. Online at http://www/hanford.gov/docs/ea/ea1135/index.html.

DOE. 2001a. *Radioactive Waste Management Manual*. DOE Manual 435.1. U.S. Department of Energy, Washington D.C. Online at: http://www.directives.doe.gov.

DOE. 2001b. *Environmental Assessment – K Basins Sludge Storage at 221-T Building, Hanford Site, Richland, Washington*. DOE/EA-1369, U.S. Department of Energy, Richland, Washington. Online at http://www.hanford.gov/netlib/ea.asp.

DOE. 2001c. *Supplement Analysis for the Tank Waste Remediation System*. DOE/EIS-0189-SA3, U.S. Department of Energy.

DOE. 2002a. *Transuranic Waste Performance Management Plan*. U.S. Department of Energy, Carlsbad, New Mexico. Online at: http://www.wiupp.carlsbad.nm.us/suyw/july20002/FTWPMP.pdf.

DOE. 2002b. *DOE's Radioactive Material Transportation Practices Manual, for Use with DOE O 460.1*. U.S. Department of Energy, Washington, D.C. Online at: http://www.directives.doe.gov/pdfs/doe/doetext/neword/460/m4602-1.pdf.

DOE and Ecology. 1996. *Tank Waste Remediation System, Hanford Site, Richland, Washington, Final Environmental Impact Statement*. DOE/EIS-0189, U.S. Department of Energy Richland Operations Office, Richland, Washington and Washington State Department of Ecology, Olympia, Washington.

DOE-RL. 1997. *Hanford Facility Dangerous Waste Permit Application, Low-Level Burial Grounds*. DOE/RL-88-20 Rev. 1., U.S. Department of Energy-Richland Operations Office, Richland, Washington.

DOE-WIPP. 2002. *Contact-handled Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant*. DOE/WIPP-02-3122, Revision 0.1. U.S. Department of Energy, Waste Isolation Pilot Plant, Carlsbad, New Mexico. Online at: http://www.wipp.ws/library/wac/CH-WACRev0.1.pdf.

DOT. 1998. *Hazardous Materials Shipments*. U.S. Department of Transportation, The Office of Hazardous Materials Safety, Research and Special Programs Administration, Washington, D.C. Online at: http//hazmat.dot.gov/pubtrain/hmship.htm.

Ecology, EPA, and DOE. 1989. *Hanford Federal Facility Agreement and Consent Order*. 89-10 REV. 5 (As Amended through December 31, 1998), Washington State Department of Ecology, U.S. Environmental Protection Agency, U.S. Department of Energy, Richland, Washington. Online at: http://www.hanford.gov/tpa/tpahome.htm.

EPA. 1989. *Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments.* EPA/530/SW-89/047, Environmental Protection Agency, Office of Solid Waste, Washington, D.C.

FH. 2003. *Hanford Site Solid Waste Management Environmental Impact Statement Technical Information Document*. HNF-4755, Rev. 1, Fluor Hanford, Inc., Richland, Washington.

NEI. 2003 *Transportation of Radioactive Materials—Safety in Motion*. Nuclear Energy Institute, Washington, D.C. Online at: http://www.nei.org/index.asp?catnum=3&catid=462.

OAR 740-100. 2000. "Vehicles: Driver: Equipment: Equipment Required and Condition of Vehicles." Oregon Administrative Rule 740-100. Salem, Oregon. Online at: http://www.sos.state.or.us/archives/rules/OARS_700/OAR_740/740_100.html.

OAR 740-110. 2000. "Transportation of Hazardous Materials." Oregon Administrative Rule 740-110. Salem, Oregon. Online at: http://arcweb.sos.state.or.us/rules/OARS_700/OAR_740/740_110.html.

RCW 70.105. "*Hazardous Waste Management Act*." Revised Code of Washington. Olympia, Washington. Online at http://www.ecy.wa.gov/laws-rules/index.html.

Tisinger, L. G. and J. P. Giroud. 1993. The Durability of HDPE Geomembranes. *Geotechnical Fabrics Report*, 11(6): 4-8.

WAC 173-303. "Dangerous Waste Regulations." Washington Administrative Code, Olympia, Washington. Online at: http://www.leg.wa.gov/wac/index.cfm?fuseaction=chapterdigest&chapter=173-303.

WAC 246-231. "Packaging and Transportation of Radioactive Materials." Washington Administrative Code, Olympia, Washington. Online at: http://www.leg.wa.gov/wac/index.cfm?fuseaction=chapterdigest&chapter=246-231.

WAC 446-50. "Transportation of Hazardous Materials." Washington Administrative Code, Olympia, Washington. Online at: http://www.leg.wa.gov/wac/index.cfm?fuseaction=chapterdigest&chapter=446-50.

Westinghouse. 2001. *WIPP Instructors to Provide Specialized Training for Indiana Emergency Response Professionals*. Westinghouse News, dated January 25, 2001. Online at: http://www.wipp.carlsbad.nm.us/pr/2001/INSTEP.pdf.